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EDITORIAL.

The Editor takes this opportunity of wishing the Readers and Contributors of THE CHEMICAL NEWS a very happy and prosperous New Year. The custom is a very old one and unfortunately, during the past few years, has been attended with not a little misgiving as to its fulfilment. But there are now many indications of brighter times ahead. The clouds of the past show signs of breaking, and here and there a gleam of sunshine gives promise of brighter things in the near future.

The War is over and the expected aftermath is developing into a decided determination for earnest work.

The writer, who for many years has been connected with THE CHEMICAL NEWS is anxious that the publication shall continue on the lines laid down by its founder, the late Sir William Crookes.

To Sir William, THE CHEMICAL NEWS was a constant source of pleasure, and for all the years the writer can remember, the work of its arrangement occupied the last few hours of the day. When the labour of the laboratory, the official and other duties of the day were over, from 9 p.m., to midnight was devoted mostly to the "NEWS". Sir William was anxious to get into its pages the first announcements of any advance in Chemical or Physical knowledge, and to endeavour that every issue should contain something new and valuable; whether the announcement of an epoch-making discovery or some little laboratory dodge to add to the efficiency of a chemical operation.

The present Editor, whose association with Sir William is tolerably well known, was entrusted by him with the work only when strength failed, and he is very anxious to maintain the character of the paper in accordance with the wishes of the Founder: to that end he counts upon the support and criticism of all workers in the world of science.

Original papers and papers communicated to Societies or Institutions of which an immediate notice or abstract is desirable are welcomed. New and select methods of Chemical Analysis and new devices for time saving or greater efficiency in the laboratory will receive prompt attention; but controversial matter or adverse criticism of other men's labour will be discouraged.

Working on these lines the Editor looks confidently to the coming year with the assurance that the pages of THE CHEMICAL NEWS will play a useful part in the continued advancement of that branch of activity that has been aptly termed "Organised Common Sense".

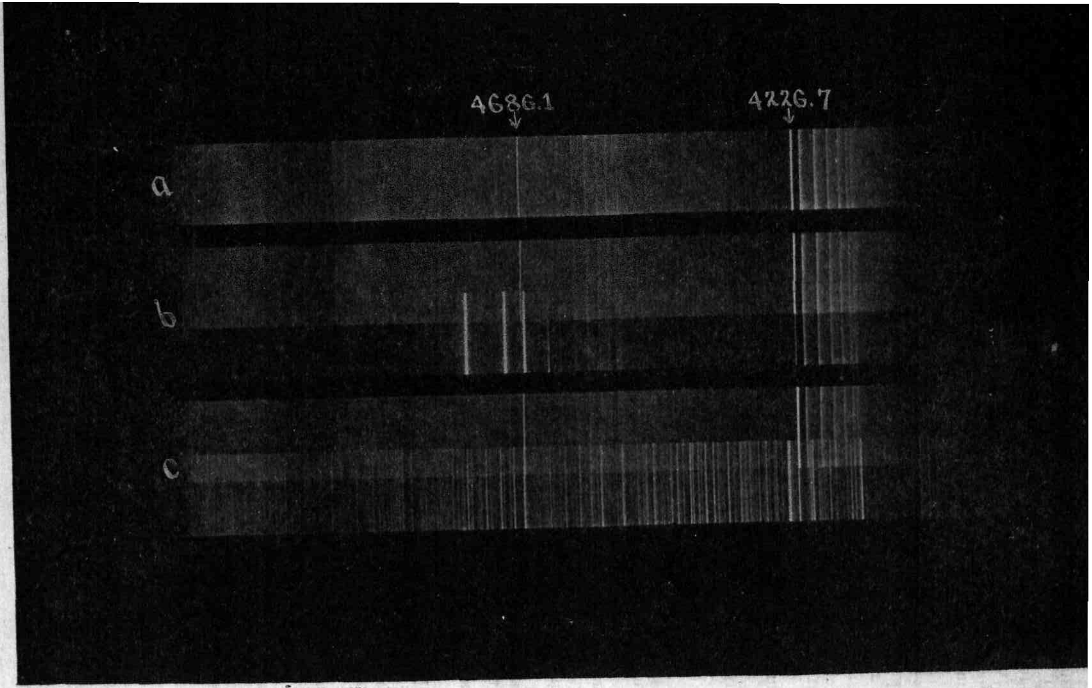

Fig. 1.

a Germanium. *b* Germanium and Zinc. *c* Germanium and Zirconium.

GERMANIUM II.

THE IDENTIFICATION OF GERMANIUM BY ITS VISIBLE ARC SPECTRUM.[1]

BY JACOB PAPISH.

HISTORICAL.

Rowland and Tatnall[2] obtained the arc spectrum of germanium from argyrodite by means of a grating spectroscope. They examined the region between λ 2300 and λ 4600, and by eliminating the lines due to known substances that were present in the argyrodite, they measured the wave-lengths and determined the intensity and character of twenty-six germanium lines. Of this number only one line, λ 4266.724 is in the visible region of the spectrum, all others being in the ultra-violet. This line is so close to a prominent calcium line (λ 4226.870) that the two overlap and appear coincident when examined through an instrument of average dispersion.

Exner and Haschek[3] measured the arc spectrum of germanium with the aid of a grating spectrograph. Their germanium material consisted of a solution obtained by treating metallic germanium with aqua regia; the metal, in turn, was procured from Clemens Winkler. They call attention to the fact that the visible line, λ 4226.724 is obscured by the very strong line of calcium.

Eder and Valenta[4] extended the visible arc spectrum of germanium by determining the wave-length of a line in the blue, λ 4686 Judging from their map, this line is rather faint, but when a prism spectroscope or spectrograph is used, the line is intense, sharp, and very suitable for the identification of germanium.

EXPERIMENTAL.

In a previous article[5] reference has been made to arc spectrographic tests as a means of identifying germanium and of testing the purity of various compounds of germanium. These tests were carried out with the aid of a Hilger constant deviation spectrograph fitted with a flint-glass prism of refractive index $n = 1.7537$. The instrument is sensitive to a wave-length range between λ 8127 and λ 3944 provided suitable plates are employed for the various regions of the spectrum. Wratten and Wainwright Panchromatic plates were used for the red-green region and Seed 30 Gilt Edge plates for the blue-violet region. Standard Orthonon and Seed's Non-Halation L Ortho plates were also found very suitable.[6] "Rytol" developer, manufactured by Burroughs, Wellcome and Company, and an acid (acetic) fixing bath were used for developing and fixing the negatives.

The arc was made between carbon or graphite electrodes. The lower electrode carried the material to be tested, and was made the positive pole. Currents of 7 to 10 amperes were usually used. Whenever it was desired to eliminate faint lines due to traces of impurities, larger currents (20 to 25 amperes) were employed. Exposures were usually of two to three seconds' duration; to bring out faint lines, the time was increased to five, eight, and even ten seconds.

The wave-length of the germanium line mentioned by Eder and Valenta (Fig. 1, a) was checked by obtaining a spectrogram of a mixture of the oxides of germanium and zinc (Fig. 1, b) and computing the value with the aid of Hartmann's interpolation formula.[7] As a further check, the spectrogram of germanium was superposed upon that of zirconium and as seen from Fig. 1, c, the blue germanium line overlaps the prominent zirconium line of wave-length 4688 A comparison was next made of the visible arc and spark spectra of germanium and it was noticed that this line is in the same position as the spark line λ 4686.1, which has been observed by Exner and Haschek.[8]

SUMMARY.

1. A review of the literature on the arc spectrum of germanium is given.

2. A blue germanium arc line, λ 4686, is mentioned as suitable for the identification of germanium.

3. A method for obtaining arc spectrograms is described.

[Contribution from the Department of Chemistry of Cornell University.]
Ithaca, N.Y.

1 This article is based upon a part of the thesis presented to the Faculty of the Graduate School of Cornell University by Jacob Papish in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

2 Astrophys. Jour., 1, 149 (1895).

3 Wellenlangen-Tabellen f. spektralanalytische Untersuchungen auf Grund der ultravioletten Bogenspektren der Elemente. Leipzig u, Wien, 1904.

4 Atlas typischer Spektren, Wien, 1911, p. 37.

5 Dennis and Papish. This Journal ———.

6 All of these plates were obtained from the Eastman Kodak Company, Rochester, N.Y.

7 Astrophys. Jour. 8, 218 (1898).

8 Wellenlängen - Tabellen f. spektralanalytische Untersuchungen auf Grund d. ultraviolletten Funkenspektren d. Elemente, 11, p. 65, Leipzig u. Wien, 1902.

Line Entities and Line Domains.*

PART II.

NOTES.

1. It must be understood that these are matters pressed to the limit of human comprehension, for one cannot state what an electron is made of, or what atomic nuclei are made of without stating what lines of force or line domains are made of. The answer is: *We do not know.* Of course, we do know the electrical properties answering to, or associated with, these conceptions, but beyond that we know nothing.

2. The quantum theory involves a discontinuity somewhere in the mechanism of radiation. In my "Atomic Theories," p. 55, it is summed up thus:—"Consequently the energy has to be 'bunched up,' or emitted spasmodically to maintain the equilibrium principle, and this leads to the *discontinuity* involved in the quantum theory." If now the line-domains form the mechanism of vibration, these taken as radial units could not vibrate as one compact assemblage of such units if their domains, as in the atom, would give them a rigidity which would preclude a homogeneous type of vibration throughout a given equipotential surface. Consequently one would have to cast about for some mechanism which would fulfill the conditions of

(i.) *general homogenity* and
(ii.) *particular discontinuity*,

still involving the line-domain conception. The problem at the start seems to be—given a spherical surface, to find out how it can vibate without either expanding or contracting: the vibration being confined to an equipotential "plane." It seems necessary to partition the surface into areas, and in the centre of each area provide an actuating point. This structure is precisely the equipotential surface of a system of radial line-domains, the central point corresponding to a section of a line of force. So far, so good, but where is the "particular discontinuity" to be located? Is it the partitionment of the domains, or is it the independence of the vibrating central unit lines? In either case, there does not appear to be any particular discontinuity involved unless there is a blocking out of some domains, which amounts to the "bunching up" of the radiations. In such a case one would expect the origins of the active domains or their lines not to be homogeneous, but to start from various scattered points, as if the vibrations of certain domains prevented others from functioning as transmitters of radiant energy. In other words, the maximum number of theoretical radial line-domains cannot all come into vibration at once, as they would interfere with one another; therefore, as they pick up the vibration one after the other, or some simutaneously, they would soon occupy the spherical space so that no more can take up the vibration. In short, the vibration causes the domains to occupy a larger volume to the exclusion of others as vibrating units, which is tantamount to the "blocking out" mentioned above.

3. Accepting the line-domain idea, it will be seen that their number need not be great enough to begin to approximate to the condition of an aether with a fine-grained molecular structure; consequently, the principle of equipartition of energy need not be violated, for it could not then be said that there was any occasion to consider all the energy ultimately residing in the small molecules. Thus Newton's laws would in this respect be sustained, for the line-domains do not correspond in any way with a large number of small vibrating molecules having a great many degrees of freedom; or an infinite number of degrees of freedom. They correspond in one sense almost to the reverse of this idea. Each line-domain has an entity characteristic, but their number need not be so very great.

4. Those who have been studying the theory of Relativity will have noticed the fundamental rôle played by the *velocity of light* without perhaps realising fully what the words imply. Some think in figures or symbols, some think mechanically, *i.e.*, in terms of mechanism. The latter method has its advantage if it is not pressed too far—as it is pictorial. In order to illustrate what is meant by the velocity of light the mechanical model method will be here developed, especially since it harmonises well with the line ideas of this paper. In this model method the magnitudes employed will be out of all proportion to anything one could practically represent in a model, but this need not matter, for it is

the *principle* of the argument that stands, whatever be the units or distances taken.

Referring to Fig. 1, W is a very long straight wire. Since the anchorage of the wire at each end does not enter into the problem, as here discussed, this mechanical feature may be eliminated from consideration. S is a long shaft, parallel to the wire, mounted in suitable bearings (not shown) and driven at a uniform speed of one revolution every four seconds. P is a small pointed arm attached to the shaft and adjusted so that once in every revolution it will engage momentarily with the wire and set it in vibration so that a wave of definite speed, wave-length and amplitude will proceed along the wire in both directions from the point of momentary contact C. At a definite distance of 186,000 units a disc D is clamped to the shaft. In reality the distance is in *miles*, but in this model a smaller unit would seem more convenient. It makes no difference, however, as it is only the proportionate quantities that are to be considered, so that by this model the velocity of light may be illustrated, but it is desirable to consider other variations. Suppose now that the observer or operator grasps the disc D loosely in his hand and runs very quickly towards P with it. He would, of course, start on the run just when the wire is plucked at C. The disc would have to be keyed losely to the shaft so as to be free to slide lengthwise. Mechanically, a long key-seat would be cut and a key fixed in a key-way cut in the disc If, to take a simplifying figure, the operator (runner) moves with the velocity of light towards P he would meet the light wave half way, and the pit on the disc will indicate that the shaft has turned through an angle of 45 degrees, this representing half a second. As velocity equals distance travelled divided by the time taken in the journey, 93,000/0.5 = 186,000, which is the velocity of light as before. So that if one rushes to meet the oncoming wave, just started, as by the model of Fig. 1, it is found that the light is moving with the same velocity as

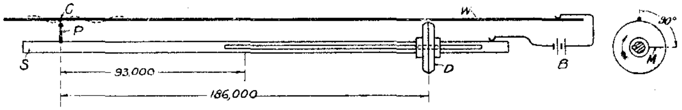

FIG 1. FIG. 2.

miles will be retained. On the side of the disc a radial mark M is engraved in a position in sighted line with the central axis of the arm P, see Fig. 2. Now the shaft is connected to one pole of a source of current supply, a few batteries B, whilst the wire W is connected to the other pole, thus completing the circuit, as the edge of the metal disc D is supposed just to touch the wire. When a wave travels along the wire, the moment the wave reaches the disc it causes the wire to break contact. A tiny arc is formed and the edge of the disc is pitted just at the moment the arc takes place. Now if the line M had moved through an angle of 90 degrees when the spark occurred, it would have indicated a lapse of *one second* as the speed of rotation of the shaft is one complete turn in four seconds. It could be said that the wave or undulation travelling along the wire took one second to cover the distance 186,000. This being *miles*, the velocity was this number of miles per second, which is the velocity of light in free space; hence, when the observer was stationary and simply noted the advance of the disc up to the time of the spark, which registers the angular displacement: being the clock in effect.

Suppose one now runs away from the oncoming wave, would the light velocity still be the same by the measurement *afforded by the mechanical model?* To carry into effect this experiment, that is to say to carry it out in principle, the runner would have to be given a *handicap*, by starting him off with the disc D in, say, a midway place H. By the time the light-wave had reached H (93,000 miles distant from P) he would have travelled a distance of H/2 (46,500 miles) if his velocity is just half that of light; and by the time the light-wave had reached the place corresponding to H/2 he would have moved on to a place represented by 46,500/2; and so on. Now if all these diminishing distances, 93,000; 46,500; 23,250; 11,625; etc., be added, this is the distance covered by the runner up to the time his disc becomes pitted with a

spark, *plus his handicap;* that is to say, when the light overtakes him. In a similar way the times have to be added thus:—$\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}$, etc., and these have to be divided into the distance covered by the runner up to the moment of the spark, to get the answer which will be the velocity of the light; for this is the whole distance travelled divided by the time taken in the journey, so that:—

$$\frac{93,000+46,500+23,250+11,625, \text{ etc.}}{\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}, \text{ etc.}} = 186,000$$

miles per second, and therefore the light velocity is the same, by the method of this model, though the runner (operator or observer) is "running away" from it.

According to this model the light velocity is always the same whatever movement the operator takes. The possibilities of the model are not yet exhausted. Suppose now that the whole apparatus except the wire itself were moving in directions parallel to the axis of the wire and at a high speed in each case. This would make no difference either, because, so far as the wave itself was concerned it would be the same, that is to say, the measurements of velocity would be the same in effect as the last two cases just cited.

The Doppler effect, however, has to be considered. If the operator with the disc is rushing towards P he would meet more wave-crests per unit of time than would *apparently* pass him if he were stationery, consequently he would observe shorter waves, which is the Doppler effect. There would be more pittings in the circumference of his disc.

If he was now moving away from P he would cross fewer crests per unit of time. If now the whole apparatus except the wire were moving from left to right, then the observer moving with the apparatus would expect to find shorter waves generated in the wire by the type of mechanism illustrated, but as these would be passed less quickly there would be compensation so that the wave-length would remain the same. Returning to the mechanism, it might be modified by introducing n radial spokes (P) in one plane normal to the axis of the shaft in order to reduce the times between each pluck of the wire. It may be assumed that the waves per unit distance are then regulated by the number of plucks and the speed (taken longitudinally) of the plucker relative to that of the wire. This involves a mechanical conception of the mechanism of radiation, and from Bohr's theory this idea may be faulty or it may require further elaboration.

Now P becomes in effect the *source of light*, so that to get any differential phenomena in the shape of a Doppler effect the operator's movement must be relative to the source P, but the velocity of light is always the same when uninfluenced by the presence of great masses of matter like the sun, or when it is not passing through more or less dense media, as in the Fizeau experiment. It may be here remarked that long light waves in free space have the same velocity as short light waves, the term *light* referring to all waves of electromagnetic origin.

As a corollary to the above, the velocity of light cannot be thought of in terms of measurement without a standard place of reference, so to speak, which becomes the point of inception of the wave. This being the case, the measurement must always be from this source, hence the constancy of the velocity of light. As a further consideration, assuming a wave of light started at some early time, when one breaks in upon such a wave train extending millions of miles for example, to speak of its velocity becomes absurd, because no origin is involved in this case. Sir O. Lodge hints at this in the following words:—"Einstein's second fundamental assumption is that the one absolute quantity which *can* be measured, namely, the velocity of light—if it be a velocity—is unique and so fundamental that every observer must necessarily measure the same result if he make his measurements correctly, no matter what his motion may be."—*Nature*, Aug. 4th, 1921.

Thus it will be seen that the absoluteness of the velocity of light follows directly from the fact that it is of necessity always measured from the source of its origin. This, of course, may be displaced a definite amount without affecting the result—it can be given a handicap as it were. Here then is a good example of the phenomenon being, so to speak, attached to its particular origin, and this is precisely the idea which obtains when considering line-domains.

* See CHEMICAL NEWS, Dec. 23 and 30, 1921, pp. 329, 350—this being practically a continuation of my previous article.

CONTACT CATALYSIS.*

By Wilder D. Bancroft.[2]

It seems probable that progress in developing a theory of contact catalysis can be accelerated if we formulate more definitely the conditions of the problem, so that we can see what experiments should be done next. The first question to be answered is whether the catalytic agent can act at a distance by radiation. Miss Woker[3] has given a sketch of the earlier speculations as to radiation. The only one which has survived is that of Barendrecht,[4] whose calculations have been criticised severely by Henri.[5] Trautz and Krüger[6] have attempted to account for a number of phenomena in homogeneous solutions by postulating infra-red radiation. This idea has been developed by Lewis[7] and applied to the change or reaction velocity with the temperature and to contact catalysis.

"Photochemical phenomena have demonstrated *the fact that chemical change can* be brought about as a result of absorption of radiation in the short-wave region. We are led to generalise this and to seek in radiation of longer wave-length the ultimate cause of ordinary or thermal reactions as well. It is obvious that every material system, in virtue of its temperature, contains radiation at the same temperature. Under ordinary *conditions, i.e., at* ordinary temperatures, this radiation is mainly of the infra-red type. It is well known that electro-magnetic properties of substances, *e.g.*, the dielectric constant, are intimately connected with the radiation density in the material, and further, such properties have a marked effect upon the chemical activity of molecules, *e.g.*, the electrolytic dissociating power of solvents which possess high dielectric constants. It will be readily *accepted, therefore, that infra-red radiation is the source of the energy which is required* to bring about ordinary or thermal reactions."

By thermal reactions Lewis means reactions of the ordinary kind which proceed without being exposed to any definite external source of short-wave radiation such as is met with in the so-called photochemical reactions.

"For our present purpose the most significant phenomenon associated with thermal *reactions is the influence of temperature* upon the reaction velocity, the velocity constant increasing three or four fold for a rise of 10° in the neighbourhood of room temperature. It has long been known that this very great effect cannot be accounted for simply on the basis of an increase in the kinetic energy of translation of the molecule as a whole, for in the most favourable case this increase could not account for more than one or two per cent. of the observed effect, *and it is doubtful whether* the change so observed would be even in the right direction. It is evident, therefore, that the effect of temperature upon the velocity constant has to do not with the kinetic energy of translation but with the internal energy of the molecule.

From measurements of the specific heat it is known that, on the average, the increase in the internal energy per degree rise in temperature is not large. In the *simplest cases the increase in internal* energy varies directly as the absolute temperature, and hence a rise of 10° would cause an increase of approximately three per cent. in the average internal energy at ordinary temperatures. The influence of temperature on velocity cannot be ascribed therefore to the average increase in internal energy. When heat is added to a body, however, the energy does not distribute itself evenly among the molecules; instead, *some receive no energy*, others a moderate amount, and a very few receive excessively great amounts of energy. It would seem therefore that the influence of temperature on reaction-speed is to be sought in the fact that a very small number of molecules receive an abnormally large quantity of internal energy.

"By treating the problem of reaction *velocity from the point of view of statistical*

*The Presidential Address presented at the Thirty-seventh General *Meeting of the American Electrochemical Society in Boston* April 8, 1920.
Transactions of The American Electrochemical Society 1920. xxxviii.

[2] By Wilder D. Bancroft, Professor of Physical Chemistry, Cornell University.

[3] Die Katalyse (1910) 60.

[4] Zeit. phys. Chem. (1904), 49, 456; (1906), 54, 307; Proc. Kon Akad. Wet. Amsterdam (1919), 22, 29.

[5] Zeit. phys. Chem. (1905), 51, 19.

[6] Zeit. Electrochemie (1911), 17, 453.

[7] Jour. Chem. Soc. (1914), 105, 2330; (1915), 107, 233; (1911), 109, 55, 67, 796; (1917), 111, 457, 1086; (1918), 113, 471; (1919), 115, 182; System of Physical Chemistry (1919), 3, 138.

mechanics it is possible to correlate the velocity constant with the temperature as has been done by Marcelin[8] and later in a more exact manner by J. Rice.[9] The relation between the observed velocity constant k and the absolute temperature T for a simple type of gaseous reaction is shown by Rice to be

$$d \log k/d\ T = E/RT^2$$

This expression is, as a matter of fact, a slightly simplified form, a small term having been neglected. In deducing this expression it has been assumed that a molecule reacts when its internal energy has been raised to a certain critical value which is in general large compared with the average internal energy of the molecule. This critical limit is known as the critical energy of the molecule. The term E denotes the difference between the critical energy and the average or mean internal energy reckoned per gram-molecule. E may therefore be called the critical increment; E denotes the amount of energy which has to be added to make an average gram-molecule react. It is at this point that the radiation hypothesis of chemical reactivity enters, the assumption being that the quantity E is contributed by the absorption of infra-red radiation of a given frequency which the substance is capable of absorbing. It is assumed that this energy is communicated in terms of quanta, the same assumption as is made by Einstein in obtaining his expression for the photochemical equivalent.

"It will be observed that the Marcelin-Rice equation is identical in form with the empirical equation of Arrhenius, which is known to be in good agreement with experiment. A considerable advance has been made, however, in that the empirical term A, which occurs in Arrhenius' equation, is now replaced by the term E to which a definite physical significance can be attached. In the case of polymolecular reactions the active molecular state actually exists, as is shown by the experiments of Baly and F. O. Rice;[10] the rate of observed chemical reaction depends then upon the frequency of collision between activated molecules.

"In the case of unimolecular change, molecules in the active state do not exist, for it is assumed that when a molecule becomes active it immediately decomposes and becomes transformed into resultant. If the action be reversible, it follows, on the statistical basis of the expression, that the activated resultant has exactly the same critical energy as the activated reactant. This does not mean that the E term is the same for both reactant and resultant, E being the difference between the critical and mean internal energies.

"Granted that the critical increment is due to radiation, and further assuming that a single quantum is capable for accounting for the E of a single molecule, it can easily be shown from a knowledge of the magnitude of the temperature coefficient of a reaction, that the effective radiation must belong to the short infra-red region, *i.e.*, of the order 1-3 μ, in the case of reactions which occur with sensible velocity at ordinary temperatures."

In order to apply this hypothesis to contact catalysis it is only necessary to postulate that the catalytic agent emits a suitable infra-red radiation, that the sum of the critical energy increments necessary to activate the reactants at the surface of the catalytic material and the energy necessary to absorb the products of the reaction are less than those required to activate the reactants in the free state.

Lewis[11] has done some remarkable work in the way of calculating absorption bands and of establishing relations between the critical energy increment and the heat of reaction; but he seems never to have shown experimentally that the reaction velocity is actually due to infra-red radiation. For instance methyl acetate has a strong absorption band between 5.8 μ and 11 μ and the hydrogen ion is supposed to emit wavelengths over the range 1.1-11 μ; but no attempt has been made to see whether infrared radiations really accelerate the catalysis of methyl acetate. Lewis[12] tries to meet this objection in an interesting way. "In order that any of Planck's relations may be employed, it is essential that temperature radiation alone be considered, and further that the radiation and the matter composing the system be in temperature equilibrium. On Planck's view, the interchange between matter and radiant energy is effected through the medium of oscillators, situated in the molecules of the matter present. In the case of photochemical reactions as ordi-

[8] Comptes rendus (1914), 158, 161.
[9] Brit. Ass. Rep., 1915, 397.
[10] Jour. Chem. Soc. (1912), 101, 1475.
[11] Jour. Chem. Soc. (1914), 105, 230; (1916), 109, 55; (1917), 111, 457, 1036.
[12] *Ibid.* (1916), 109, 796; System of Physical Chemistry (1919), 2, 138.

narily carried out, the temperature of radiation is much higher than that of the system on which the radiation acts. To such cases Planck's expressions do not apply. It is necessary to emphasise this point, as it is not generally recognised that there is this fundamental difference between thermal and photochemical processes."

I am not prepared to admit the existence of this fundamental difference. While it is perfectly true that in photochemical work, the source of light is at a higher temperature than the object which reacts photochemically, that is merely an experimental convenience and not a theoretical necessity. The essential thing is to have wave-lengths which are absorbed by the reacting substance and it is immaterial how they are generated. If we could generate them mechanically at ordinary temperature, they would have the same photochemical action.

This point is not essential, however. If the catalytic action of hydrogen ion, for instance, is due to infra-red radiation, we ought to get acceleration when the hydrogen ion is in another vessel, provided the vessel and the solvent do not absorb those particular infra-red radiations which are assumed to be effective. It is not a question of difference of temperature. In the same way, it ought not to be necessary theoretically to bring the mixture of sulphur dioxide and air in actual contact with the platinum. This would eliminate the danger of poisoning the catalytic agent. It is possible that this can be done; but I know of no experiments showing it, and I am not certain that Lewis really believes that it can be done since he assumes[13] that gases are adsorbed in the atomic form and are therefore more active because the heat of dissociation may be ten times the heat of adsorption or condensation.

Lewis[14] does say: "It is evident that the optimum condition for the transfer of a quantum from a catalyst individual to a molecule of reactant occurs when the two are in contact and this according to the theory of probabilities is proportional to the product of the concentrations of the reactant and catalyst." This is taking rediation in a very narrow sense. Rideal[15] apparently agrees with Lewis and yet says that "the conception that adsorption is the primary action in all cases of heterogeneous catalysis is the viewpoint now generally adopted." I do not myself see any necessary connection between adsorption and a theory of contact catalysis based on infra-red radiations unless one is to assume explicitly that the infra-red radiations do not reach appreciably beyond the adsorption layer, in which case we are not dealing with action at a distance and it becomes impossible at present to say whether any of the effects are really due to infra-red radiation.

Until some proof is brought that a contact catalytic agent can act at a distance, we are justified in postulating that the reaction takes place in or at the surface. A corollary from this is that any substance, which cuts down the rate at which the reacting substances reach the catalytic surface[16] or which prevents them from reaching it, will decrease the reaction velocity and may destroy the catalytic action entirely. Berliner[17] has shown that traces of fatty vapours from the air or from the grease on the stop-cocks will decrease the adsorption of hydrogen by palladium from nearly nine hundred volumes practically to nothing. Faraday[18] has shown that traces of grease destroy the catalytic action of platinum on oxyhydrogen gas. De Hemptinne[19] has apparently shown that carbon monoxide cuts down the adsorption of hydrogen by palladium, though his method of presenting his results is very obscure. Lunge and Harbeck[20] found that carbon monoxide inhibits practically completely the catalytic action of platinum on a mixture of ethylene and hdrogyen. Schönbein[21] pointed out that the hydrides of sulphur, tellurium, selenium, phosphorus, arsenic, and antimony act very energetically in cutting down the catalytic action of platinum on mixtures of air with hydrogen or ether. He considered that the hydride must decompose, giving rise to a solid film. This is not necessary in order to account for the phenomenon; but he seems to have been rigbt in at least one case, for Maxted[22] has found that hydrogen sulphide is decom-

[13] Lewis: Jour. Chem. Soc. (1919), 115, 184.
[14] Jour. Chem. Soc. (1916), 109, 800.
[15] Trans. Am. Electrochem. Soc. (1919), 36, 195.

[16] Taylor: Trans. Am. Electrochem. Soc. (1919), 36, 149.
[17] Wied. Ann. (1888), 35, 903.
[18] Experimental Researches on Electricity (1839), 1, 185.
[19] Zeit. phys. Chem. (1898), 27, 249.
[20] Zeit. anorg. Chem. (1898), 16, 50.
[21] Jour. prakt. Chem. (1843), 29, 238.
[22] Jour. Chem. Soc. (1919), 115, 1050.

posed by platinum black with evolution of hydrogen and that the platinum then does not adsorb hydrogen.

Langmuir[23] points out that "the action of oxygen in preventing the dissociation of hydrogen by a heated tungsten filament is clearly that of a catalytic poison. It has been shown previously[24] that the dissociation of hydrogen takes place only among hydrogen molecules adsorbed on the surface of the tungsten. The only way in which oxygen can prevent such action in a high vacuum is by the actual presence of oxygen atoms on the surface. Since the dissociation at 1.500° K. is entirely prevented by the oxygen, and since the range of atomic and molecular forces does not exceed the dimensions of the atoms, it must follow that much more than half the surface must be covered by oxygen atoms or molecules. For if the surface were only half covered, then, according to probability laws, uncovered areas several times as large as the diameters of atoms would not be of rare occurrence, and on these areas dissociation could occur."

[23] Jour. Am. Chem. Soc. (1916), 38, 2272.
[24] *Ibid.* (1916), 38, 1145.

(To be continued)

THE BOARD OF TRADE.

SAFEGUARDING OF INDUSTRIES ACT.

TWO COMMITTEES APPOINED UNDER PART II.

Under the powers conferred upon them by Part II. of the above Act the Board of Trade have referred to a Committee, of which Dr. J. H. Clapham, C.B.E., is the Chairman, a complaint that Gold Leaf manufactured in Germany is being sold, or offered for sale, in the United Kingdom, under conditions to which the Safeguarding of Industries Act applies. The Committee propose to hold their first sitting for taking evidence at 2.30 p.m., on Monday, 9th January, 1922, at 5, Old Palace Yard, London, S.W.I. The Secretary to the Committee is Mr. D. Haigh, Board of Trade, Great George Street, London, S.W.1, to whom all communications should be addressed.

Reference has also been made to a Committee, of which Sir W. M. Acworth is the Chairman, a complaint that Aluminium Hollow-ware, Wrought Enamelled Hollow-ware, and Plain and Enamelled Baths manufactured in Germany are being sold, or offered for sale, in the United Kingdom under conditions to which the Act applies. This Committee propose to hold their first sitting for taking evidence at 2.30 p.m., on Monday, 9th January, 1922. The Secretary of this Committee is Mr. H. F. Hile, Board of Trade, Great George Street, London, S.W.1, to whom all communications should be addressed.

SAFEGUARDING OF INDUSTRIES ACT. PART I.

EXCLUSION OF SANTONINE.

The Board of Trade announce that the Referee, after hearing a complaint under Section 1 (5) that Santonine had been improperly included in the lists of articles chargeable with duty under Part I of the Act, has given a judgment upholding the complaint; and accordingly Santonine is withdrawn from the lists as from the 20th December.

RUBBER PAPER FOR NEWSPAPERS.

The London correspondent of the *Manchester Guardian Commercial* writes in to-day's issue:—"Researches which have been going on in London for some time past point to the strong probability that newspapers will at no great distance of time be printed on paper produced from rubber instead of on paper made from wood-pulp, as now. I learn that the results already derived from the investigations are such that art paper of the kind used in the production of fashion journals and the big illustrated newspapers can be made from rubber. Further experiments are to be made with a view to making newsprint from the same material, and it is on this point, perhaps, that interest in the printing industry will mainly centre.

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY 1915-1918.

No. 4.

THE THEORY AND PRACTICE OF ACID MIXING.

A special series of reports is being published for the Department of Scientific and Industrial Research in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of

the Ministry of Munitions. The work recorded was done at or in connection with some of the National Factories during the War. The preparation of the necessary abstracts of information was begun by the Ministry of Munitions at the close of the War, and arrangements were afterwards made by the Department of Scientific and Industrial Research to complete them.

Three reports of these series have already been published, viz.:—

No. 1. Recovery of Sulphuric and Nitric Acids from Acids used in the Manufacture of Explosives: Denitration and Absorption. Price 12s. 6d., by post 13s.

No. 2. Manufacture of Trinitrotoluene (TNT). Price 17s. 6d., by post 18s.

No. 3. Sulphuric Acid Concentration. Price 12s., by post 12s. 7d.

Copies of these reports may be obtained from H.M. Stationery Office at the following addresses:—

Imperial House, Kingsway, London, W.C.2, and
28, Abingdon Street, London, S.W.1;
37, Peter Street, Manchester;
1, St. Andrew's Crescent, Cardiff;
23, Forth Street, Edinburgh; or from
E. Ponsonby, Ltd., 116, Grafton Street, Dublin;

or through any bookseller.

UNEMPLOYMENT AMONG MINERS.

Unemployment among the workers of the mining industry tends steadily to decrease, while there is also a decline in the number of men on systematic short time.

According to the Board of Trade figures, the estimated number of insured workpeople in the industry is at present 1,140,670. The number of unemployment books remaining lodged on December 2nd was 139,335, which represents a percentage of 12.2, or 1.7 per cent. less than on November 4th.

Compared with the other great industries of the country, unemployment in the mining districts is not high.

BRITISH INDUSTRIES FAIR.

WHITE CITY, LONDON, AND CASTLE BROMWICH AERODROME, BIRMINGHAM.

February 27th to March 10th, 1922.

London.—Musical Instruments; Furniture and Basketware; Sports Goods, Toys, etc.; Jewellery, Silverware, Cutlery, etc.; Printing; Fancy Goods, Travelling Requisites, etc.; Brushware; Pottery and Glassware; Foodstuffs and Beverages; Boots and Shoes, Leather, etc. Apply to Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

33645—Chenische Fabrik in Billwater.—Process of producing high percentage pure anthracene. December 14.

33980—Dyson, H. G. T.—Flush chemical valve. December 17.

33370—Gulf Refining Co.—Recovery of aluminium chloride. December 12.

33532.—Hadden, A. J. H.—Treating liquids with decolorizing, purifying and filtering agents and separating undissolved substances from liquids. December 13.

33661—Hilditch, T. P.—Metanation of water gas and manufacture of methane. December 14.

33441—Koch, M.—Manufacture of pure nitro-carbonic acid mixture from combustion gases. December 14.

Specifications Published this Week.

172,046—Thermal Industrial and Chemical Research Co.—Process for de-tinning iron.

172,056—Imray, O. Y.—Manufacture of easily soluble diazotisable azo-dyestuffs.

172,074—Naef, E. E.—Recovery of sulphur from sulphuretted hydrogen and ammonium sulphide and gases containing such.

172,101—Perkins, W. G.—Treatment of complex sulphide ores.

172,177—Imray, O. Y.—Manufacture of new dyestuffs.

172,205—Schantz, K.—Manufacture of bichloride or mercure.

Abstract Published this Week.

Alkyl Amides of Aromatic Sulphonic Acids.—Patent No. 167,941.—A process of obtaining Alkyl Amides of Aromatic Sulphonic Acids has been invented by Messrs. Chemical Manufacturing Co., Ltd., of 8, Waterloo Place, London. Aromatic sulpho-chlorides, alkylamine salts, and substances neutralizing the acid produced, for instance alkaline-earth or alkali carbonates, are caused to react in the presence of a small quantity of water, not exceeding 10 per cent. and preferably less than 5 per cent. of the weight of the reagents. A solvent or deluent such as benzol may be added. Heat may be applied. The alkyl sulphonamide produced ,for instance monomethyl zylene sulphonamide, may be extracted with benzol. Dialkyl amides may be also prepared by the process. If larger quantities of water are used and the base omitted, there is obtained a compound readily soluable in water, probably a substituted ammonium compound.

Messrs Raynor & Co. will obtain printed copies of the published specifications and will forward on post free for the sum of 1s. each.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER 1922.
FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

January 20.—Sir James Dewar, LL.D., D.Sc., F.R.S., M.R.I., Fullerian Prof. of Chemistry. —"Soap Films and Molecular Forces."

January 27.—Viscount Burnham, J.P.—"Journalism."

February 3.—Lieut.-Colonel Sir Francis Younghusband, K.C.S.I., K.C.I.E.—"The Mount Everest Expedition."

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—"The Teeth of the Nation."

February 17.—Dr. S. M. Watson, M.Sc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—"History of the Mammalian Ear."

February 24.—John Joly, D.Sc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot-Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., F.R.S., M.R.I., Prof. of Chemistry University of London. —"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I. —"Evolution of the Elements."

Mr. A. A. Campbell Swinton, M.Inst.C.E., F.R.S., will give a lecture on "The Johnsen-Rahbek Electrostatic Telephone an dits Predecessors," at 4 p.m., on January 4th, and at 8 p.m., on January 5th. Mr. F. Harrison Glew will give a lecture on "Radium; its application in Peace and War," at 8 p.m., on January 4th, Professor F. J. Cheshire, C.B.E., being in the chair. All the lectures will be illustrated by experiments. Other discourses are being arranged. Over 50 firms are exhibiting scientific apparatus and a number of experimental demonstrations have been arranged.

We understand that invitations have been given to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London, and the Rontgen Society. Admission in all cases will be by ticket only, and therefore members of the societies just mentioned desiring to attend the exhibition should apply to the secretary of the society to which they belong., Others interested should apply direct to F. E. Smith, O.B.E., F.R.S., Hon. Secretary of the Physical Society, Admiralty Research Laboratory, Teddington, S.W.

THE OPTICAL SOCIETY.

The next ordinary meeting of the Society will be held at the Imperial College, on Thursday January 12, 1922, at 7.30 p.m.

The following papers will be presented:—

"The Manufacture of Optical Glass." By Dr. C. J. Peddle, M.B.E., F.I.C., F.Inst.P.

"The Barr and Stroud 100-ft. self-contained Base Rangefinder." By Dr. James W. French, F.Inst.P.

"The Optical Three Apertures Problem." By T. Smith, M.A., F.Inst.P.

THE PHYSICAL SOCIETY AND OPTICAL SOCIETY'S ANNUAL EXHIBITION.

This exhibition, which is to be held on Wednesday and Thursday, January 4th and 5th, 1922 at the Imperial College of Science, South Kensington, will be open in the afternoon (from 3 to 6 p.m.), and in the evening (from 7 to 10 p.m.)

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the MANAGER.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3222.

CONTACT CATALYSIS.

By Wilder D. Bancroft.

(*Continued from last week.*)

Harned[25] has shown that the rate of adsorption[26] of chlorpicrin by a charcoal which has been cleaned by washing with chlorpicrin is much greater at first than by a charcoal which has not been so cleaned, *although the final equilibrium is apparently* about the same in the two cases. This is analogous to the evaporation of water when covered by an oil film. The oil cuts down the rate of evaporation very much, but has practically no effect on the partial pressure of water at equilibrium. Taylor points out that normally the time of contact between a gas and the solid catalytic agent is extremely small and consequently anything which decreases the rate of adsorption will cut down the reaction velocity very much.

It is easy to see that the piling up of the reaction products will cut down the reaction velocity, if they prevent the reacting substances from coming in contact with the catalytic agent. This has been observed in the contact sulphuric acid process.[27] The explanation that the decrease in the reaction velocity is due to a decreased adsorption of the reacting substances was first given by Fink,[28] who is the real pioneer in this line. Although the reaction between carbon monoxide and oxygen is practically irreversible at ordinary temperature, Henry[29] recognized that the presence of the reaction product might slow up the rate of reaction, and he proved his point by increasing the reaction velocity when he removed the carbon dioxide with caustic potash. Water vapor checks the catalytic dehydration of ether[30] and of alcohol[31] and hydrogen cuts down the catalytic dehydrogenation of alcohol.

W. C. McC. Lewis[32] points out that the explanation of the poisoning of catalytic agents on the basis of adsorption leads to certain conclusions in regard to the temperature co-efficient. "One of the chief difficulties met with in the kinetics of heterogeneous reactions has its origin in the selective nature of the adsorbability of the reactants and the resultants, particularly the latter. The so-called catalytic poisons are now generally regarded as owing their effect to marked selective adsorption, as a result of which the surface of the catalyst becomes covered with a layer of molecules and is thus no longer capable of catalyzing the reaction. In many cases the resultants of the reaction are adsorbed in this manner and consequently function as a catalytic poison. Since the extent of adsorption diminishes as the temperature rises, it is obvious that when such poisoning effects are present the temperature co-efficient of the reaction velocity over a certain range of temperature is not comparable with that over a different range, for the total observed velocity depends not only on the true effect of temperature on the chemical process, itself, but likewise on the alteration in the extent of active surface presented to the reactants. The simplest conditions are obviously those in which the adsorption effects are a minimum, and such conditions will occur generally when the energy required for sublimation or desorption is small. In the other cases, where adsorption effects are large, it is necessary to correct the observed velocity constants for the change in the area of the effective surface produced as a result of the change in temperature. Thus in the case in which the resultant is markedly adsorbed, and therefore acts as a negative catalyist, the temperature co-efficient will possess too high a value and, instead of decreasing as tem-

25 Jour. Am. Chem. Soc. (1920), 42, 946.

26 Taylor: Trans. am. Electrochem. Soc. (1919), 36, 149.

27 Bodländer and Koppen: Zeit. Elektrochemie (1903), 9, 566; Beil: Zeit. anorg. Chem. (1905), 44, 267.

28 Bodenstein and Fink: Zeit. phys Chem. (1907), 60, 61.

29 Phil. Mag. (1836), (3), 9, 324.

30 Ipatieff: Ber. deutsch. chem. Ges. (1904), 37, 2996.

31 Engelder: Jour. Phys. Chem. (1917), 21, 676.

32 Jour Chem. Soc. (1919), 115, 182.

perature rises, may even increase. A similar abnormal behavior is to be anticipated when a reaction proceeds partly in the homogeneous gaseous phase, partly in the surface, for, as the temperature rises, the reaction tends to predominate in the gaseous phase, and therefore possesses a higher temperature co-efficient."

We have seen that the poisoning of a catalytic agent is due to marked adsorption, which cuts down the adsorption of the reacting substances. We have also seen that the presence of sulphur trioxide tends to decrease the rate of reaction of sulphur dioxide and oxygen. We can now imagine a hypothetical case in which one of the reaction products is adsorbed so strongly that it acts as a poison. In that case we shall get entirely different results depending on the amount of catalytic agent present. If there is a large excess of catalytic agent the reaction will run to an end or to true equilibrium before the catalytic agent is entirely poisoned. If, on the other hand, there is only a small amount of catalytic agent, it will be poisoned very early in the course of the reaction and we shall have an apparent equilibrium reached from only one side which will vary with the amount of catalytic agent. For any given amount of catalytic agent we shall get an apparently definite end-point; but the value of the end-point will vary with the amount of catalytic agent taken. At least one case of this sort has been recognized definitely. Neilson[33] has studied the splitting of salicin and of amygdalin by platinum black. "It is found that the amount of splitting of salicin in a given time reached a maximum, and then with increasing time the amount of splitting was not proportional to the time, being materially less in the last twenty-four hours than it was in the preceding. This is due, no doubt, to the effect of the products of the splitting—especially the saligenin. It is more probably due, however, to the salicylic acid produced by the oxidation of saligenin to salicylic acid by the platinum. It is well known that salicylic acid has a marked retarding action on enzymes as shown by Kastle and Loevenhart[34] in its action on lipase; and by Neilson[35] in its action on platinum black in the hydrolysis of ethyl butyrate.

"The experiments with amygdalin and platinum black were carried out in the same way as those with salicin. It was anticipated, however, that the amount of splitting by the action of platinum black on the amygdalin would be small, as it is well known from Bredig's work on the catalysis of hydrogen peroxide by colloidal platinum,[36] and from Neilson's work[37] on the hydrolysis of ethyl butyrate by platinum black, that hydrocyanic acid has a marked retarding action on the catalytic action of platinum. One of the splitting products of amygdalin is hydrocyanic acid; and according to the above experiments one would expect the action of platinum black on amygdalin to be retarded, if not stopped entirely. Such, indeed, was found to be the case, as the first experiment with tightly corked flasks was entirely negative. It occurred to me that by leaving the flasks uncorked the hydrocyanic acid would volatilize and the action would then proceed. This is in keeping with the well-known fact that removing one of the products of a chemical reaction allows the action to go on to completion. By leaving the flasks uncorked it was found by a qualitative test that platinum splits up the amygdalin. It was further seen that the action did not go on to completion, as the amount of sugar produced was small."

Since enzymes are poisoned by many substances in something the same way that colloidal platinum is, it seems worth while to see whether autotoxic catalysis would account for some of the peculiarities in enzyme action which have puzzled people. If autotoxic catalysis occurs, we should expect that the presence of the reaction products would cut down the reaction velocity even though the reverse reactions were negligible. If the poisoning action of the reaction products is sufficient, we should get false equilibria if we started with small amounts of the enzymes and the reaction would run to an end if we took larger amounts of the enzymes. Both these phenomena have been observed.[38]

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34 Am. Chem. Jour. (1900), 24, 491.
33 Am. Jour. Physiology (1906), 15, 148.
35 Am. Jour. Physiology (1903), 10, 197.
36 Bredig: Anorganische Fermente (1900), 68.
37 Neilson: Am. Jour. Physiology (1903), 10, 197.
38 Tammann: Zeit. phys. Chem. (1895), 18, 426; Kastle and Loevenhart: Am. Chem. Jour. (1900), 24, 491.

The poisoning of colloidal platinum in its action on hydrogen peroxide solutions is undoubtedly due to adsorption; but we have no direct measurements on the adsorption and consequently we do not know positively that this is the right explanation and we do not know that there may not be other factors which have been overlooked.

Since reaction velocity is probably directly proportional to the difference of chemical potential and inversely proportional to the chemical resistance, we can increase the reaction velocity either by increasing the difference of chemical potential or by decreasing the chemical resistance. When the reacting substances are adsorbed at the surface of a catalytic agent, there is a marked increase in the concentration and it has been suggested that this is the cause of catalytic action. As a matter of fact, the effect of concentration seems to be relatively unimportant in most of the cases studied hitherto. Patrick's silica gel has a surface of 2.5×10^6 cm^2 per gram and is an excellent adsorbent; but, so far, it does not have any marked catalytic effect except in the oxidation of nitric oxide. It would be interesting to try this substance at 100° with the mixed vapors of alcohol and acetic acid, because this reaction takes place at a measurable rate in the vapor phase in the absence of any catalytic agent. It is stated that oxyhydrogen gas has been found to be quite stable under pressures of two thousand atmospheres, which shows that the catalytic action of platinum on mixtures of hydrogen and oxygen must be due to something more than a change in concentration. The marked difference in the behavior of platinum and charcoal toward oxyhydrogen gas is another argument in favor of the action of a catalytic agent being specific.

If we have selective adsorption of the reaction products, this will cause a lowering of the chemical potential of the resultants[39] and will therefore increase the reaction velocity. It may even determine the direction of the reaction. Alcohol breaks down into acetaldehyde and hydrogen in presence of pulverulent nickel and into ethylene and water in presence of pulverulent alumina. Since nickel adsorbs hydrogen strongly and alumnia adsorbs water, it seems natural to assume that the selective adsorption is the determining factor.[40]

While this seems very satisfactory, there are certain points which must not be overlooked. When making ethylene at Edgewood Arsenal during the war, it was found advisable to have a large amount of steam present with the alcohol vapor in order to make temperature regulation easier. This undoubtedly decreased the rate of decomposition of the alcohol; but that difficulty was overcome by working at a higher temperature. I find it very difficult to see how alumina can dehydrate alcohol in presence of a large amount of water vapor if the reason the alumina acts is because of its strong adsorption of water vapor. In spite of the fact that the selective adsorption of the reaction products is my own pet theory and in spite of the fact that it undoubtedly contains a great amount of truth, it must be admitted that, as now formulated, it is not the final word. It must be modified before it can be considered as satisfactory. If it breaks down temporarily in the simple case of the decomposition of alcohol, it is not surprising that we cannot as yet predict the decompositions of the esters by means of it.

If changes in the chemical potential are not the important factors in contact catalysis, the catalytic agent must change the chemical resistance in some way. So far as I can see, there are two possible ways in which this might happen. We may have more effective collisions between existing molecules or we may have a conversion of one or more of the reacting substances into an active form.

According to the kinetic theory the reaction velocity is proportional to the number of collisions between possibly reacting molecules; but it does not follow at all that two molecules react every time they collide. If a large number of collisions is necessary on an average before a pair of molecules react, anything which would make these collisions more helpful might increase the reaction velocity enormously. The first question is then whether there is any evidence of ineffective collisions. This matter has been studied by Strutt,[41] who comes to the conclusion that a molecule of ozone reacts every time it strikes a molecule of silver oxide; but that a molecule of active nitrogen collides with a molecule of copper oxide five

[39] W. C. McC. Lewis suggests the terms reactants and resultants for reacting substances and reaction products.

[40] Bancroft: Jour. Phys. Chem. (1917), 21, 591.

hundred times on an average before they react, while two molecules of ozone at 100° collide on an average 6 x 10⁸ times before they react. Without insisting on the absolute accuracy of these figures there is evidently plenty of margin for an increase in reaction velocity with ozone at 100° if one could produce more effective collisions. Langmuir[42] finds that 15 percent of all oxygen molecules at a pressure of not over 5 bars striking a tungsten filament at 2770° K react with it to form tungstic oxide, WO_3. This co-efficient increases at higher temperatures and at 3300° K about 50 percent of all the oxygen molecules which strike the filament react with it to form WO_3. Since there are three atoms of oxygen in WO_3 and only two in the oxygen molecule, Langmuir considers that at least one-half of the tungsten surface must be covered at 3300° K with oxygen in some form.

41 Proc. Roy. Soc. (1912), 87, A, 302.
42 Jour. Am. Chem. Soc. (1913), 35, 105; (1916), 38, 2270.

JAPANESE PATENT LAW.

H.M. Ambassador at Tokio reports that by Imperial Ordinance, published in the Official Gazette, dated December 17th, 1921, the revised Law relating to patents, trade-marks, etc., and intituled "The Utility Model Law" (Law No. 97, promulgated on April 29th, 1921, in "Official Gazette" No. 2622 of Saturday, April 30th, 1921), will be enforced as from January 11th, 1922.

A copy of the Law may be inspected by United Kingdom firms interested on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. The regulations concerning the enforcement of the Law have not yet been received in the Department. Upon receipt of such regulations a further announcement will appear in the "Journal."

TRANSITION ELEMENTS AND THE OCTET THEORY.

With a new arrangement of the Rare Earth Elements in the Periodic Classification.

By R. G. W. NORRISH, B.A. (Cantab).

It is now considered probable by many that in the Lewis-Langmuir theory we have the nucleus of a consistent explanation of the Periodic properties of the elements. Nevertheless the theory in its present stage is not entirely satisfactory and certain disadvantages have yet to be overcome. The most important of these, in the opinion of the author, are those connected with the elements commonly known as the transition elements, the elements leading up to them in the Periodic Table, and with the Rare Earth metals.

The chemical properties of these elements are not satisfactorily explained in all their relationships by the electronic arrangement laid down by Langmuir's fourth postulate,[1] and to obtain a consistent explanation it appears to be necessary to adopt the idea of variability of electronic structure for the elements in question. This possibility has already been dealt with by one author[2] with a certain measure of success, although the question cannot be said to be in a satisfactory state. It is the object of this paper to examine the question from the point of view of colour and valency relations, which will be shown to lead to the periodic arrangement adopted in Table I.

It will be observed that in the first long period there are eight consecutive elements, commencing with Titanium and ending with Copper, all of which give coloured cations in solution. Furthermore all except Copper and Nickel give two series of cations, the one divalent and the other trivalent. The elements preceding Titanium, and those following Copper in the long series in question are all colourless in the ionic state, and nearly always exhibit only their normal group valency.

The following series of salts may be cited as an example of the above statement.

[1] *According to Langmuir's fourth postulate the electrons in the atom tend to arrange themselves in concentric shells round the central nucleus; of these the first contains two electrons, the second eight, the third eight, the fourth eighteen, the fifth eighteen, and the sixth thirty-two. Thus the third shell is completed by the element Argon, while the fourth is commenced with Potassium, with one electron in the outer shell, and completed with Krypton with eighteen electrons outside, each successive element in this long series having one more electron in the outer shell than in the element preceding it.*

[2] *R. Bury; Jour. Am. Chem. Soc.* (1921), 43, *p.* 1062.

F = Infra Red Vibration Frequency ÷ 10^2

L = Latent Heat of evaporation per gm-mol.

C = Compressibility × 10^{-6}

S = Magnetic Susceptibility per gm × 10^6

Variable Elements in Rectangle.

Series ↓	Group: 0.	1a.	2a.	3a.	4a.	5a.	6a.	7a.	8a.	8.	8b.	1b.	2b.	3b.	4b.	5b.	6b.	7b.	0°.
		H 1 F. 4·36 L. 229																	He 2 F. 0·66 S -0·002
I	He 2 F. ·66 S -0·002	Li 3 F. 10·0 L. 29,900 C. 8·8 S +0·38	Be 4 F 18·5 S +0·78	B 5 S -0·7											C 6 F 27·7 C. 3·5 S -2·0	N 7 F. 2·5 L. 1563	O 8 F. 1·7 L. 1599 S +	F 9 F. 1·8	Ne 10 F. 0·34
II	Ne 10 F. 0·34	Na 11 F. 3·96 L. 20,500 C. 15·4 S +0·51	Mg 12 F. 7·2 L. 33,200 C. 2·7 S +0·55	Al 13 F. 7·5 L. 52,600 C. 1·3 S +0·6											Si 14 F 9·6 C. 1·6	P 15 F. 6·3 L. 400 C. 9 S -0·9	S. 16 F 2·16 L. 11,580 C. 12·5 S -0·34	Cl 17 F. 2·24 L. 2,300 C. 95 S -0·59	Ar 18 F. 1·32 S -0·1
III	Ar 18 F. 1·32 S -0·1	K 19 F. 2·3 L. 17,900 C. 31·5 S +0·4	Ca 20 F. 4·8 C. 5·5	Sc 21	Ti 22 F. 8·4 S +3·1	V 23 F. 8·3 S +1·5	Cr 24 F. 8·3 L. 88,200 C. 0·7 S +0·37	Mn 25 F. 7·5 L. 60,300 C. 0·67 S +11·0	Fe 26 F. 8·3 L. 77,304 C. 0·4 S +∞	Co 27 F. 8·2 C. S +∞	Ni 28 F. 8·2 L. 76,500 C. 0·27 S +∞	Cu 29 F. 6·7 L. 75,400 C. 0·54 S -0·08	Zn 30 F. 4·36 L. 28,800 C. 1·5 S -0·24	Ga 31 F. 2·5 S -0·23	Ge 32 F. 4·6	As 33 F. 4·36 L. 30,500 C. 4·4 S -0·3	Se 34 F. 2·7 C. 11·8 S -0·6	Br 35 F. 1·7 L. 3,640 C. 51·8 S -0·41	Kr 36 F. 0·9
IV	Kr 36 F. 0·9	Rb 37 F. 1·45 L. 15,240 C. 40·0	Sr 38 F. 5·0	Y 39	Zr 40 S -0·45	Nb 41 S +1·3	Mo 42 F. 6·3 L. 177,900 C. 0·26 S +0·04	43	Ru 44	Rh 45 S +1·1	Pd 46 F. 5·74 C. 0·38 S +5·2	Ag 47 F. 4·36 L. 33,700 C. 0·84 S -0·02	Cd 48 F. 3·0 L. 25,000 C. 1·9 S -0·17	In 49 F. 2·1 S -0·1	Sn 50 F. 2·24 L. 69,000 C. 1·7 S +0·003	Sb 51 F. 3·0 L. 41,000 C. 2·2 S -4·4	Te 52 F. 2·45 C. 13·0 S -0·31	I 53 F. 1·6 L. 3040 C. 13·0 S -0·39	Xe 54 F. 0·85
	Xe 54 F. 0·85	Cs 55 F. 0·95 L. 16,180 C. 61·0	Ba 56 F. 2·4	La 57 F 2·8	Ce 58 S +15	Pr 59 S +36	Nd 60	61	Sa 62 S +	Eu 63 S +	Gd 64 S +								
V					Tb 65	Dy 66	Ho 67	Er 68 S +25	Tm_1 69	Tm_2 70	Yb 71 S +33·6								
					Lu 72	Ta 73 F 4·05 S +0·9	W 74 L. 21,500 S +0·35	75	Os 76 F 5·1 S +0·04	Ir 77 F. 4·05 S +0·15	Pt 78 F. 4·36 L. 128,000 C. 0·21 S +1·1	Au 79 F. 3·4 L. 65,500 C. 0·8 S -3·1	Hg 80 F. 1·25 L. 13,600 C. 3·71 C -0·19	Tl 81 F. 1·84 L. 40,000 C. 2·6 S -0·22	Pb 82 F 1·84 L. 45,400 C. 2·2 S -0·12	Bi 83 F. 1·6 C 2·8 S -0·14	84	85	Nt 86
VI	Nt 86	87	Ra 88	89	Th 90 S +0·18	UrX 91	Ur 92												

TABLE II.

Trivalent Series.	Colour	Divalent Series	Colour
ScCl	Colourless	$CaCl_2$	Colourless
$TiCl_3$	Violet	$TiCl_2$	Yellow
$V\ Cl_3$	Green	$V\ Cl_2$	Lavender
$CrCl_3$	Green	$CrCl_2$	Blue
$MnCl_3$	Green	$MnCl_2$	Pink
$FeCl_3$	Yellow	$FeCl_2$	Green
$CoCl_3$	Red	$CoCl_2$	Blue
		$NiCl_2$	Green
		$CuCl_2$	Blue
$GaCl_3$	Colourless	$ZnCl_2$	Colourless

The fact that these elements are able to form trivalent ions indicates that there are in all cases three loose electrons which can be lost to a negative element or radicle in salt formation. In the formation of the divalent series of salts only two of the electrons are utilised. The following Table gives the number of ions remaining in the outermost shell of the ions in the two series of salts.

It will be convenient to call this outermost shell of electrons of the above ions the *Subsidiary Shell.* In the case of Copper immediately following Nickel in the Periodic Classification, the subsidiary shell consists of 8 electrons, while there are *in the case of the metal* 3 electrons outside, corresponding to the three electrons lost in salt-formation in the case of the elements considered above. Of these either two or one can function as valency electrons. In the former state it is assumed that as the subsidiary shell now contains 8 electrons, there is no tendency for it to absorb more, and the remaining electron of the "Cupric ion

TABLE III.

-ic Salts Trivalent Ions	No. of Electrons in outside shell	-ous Salts Divalent Ions	No. of Electrons in outside shell
Ti'''	1	Ti''	2
V	2	V''	3
Cr	3	Cr''	4
Mn	4	Mn''	5
Fe	5	Fe''	6
Co	6	Co''	7
(Ni)	(7)	Ni''	8

Cu'' will remain outside loosely held and is probably responsible for the colour of the ion. In the case of the Cuprous ion there are two electrous outside, which form a stable pair, analogous to the pair of electrons in the Helium atom; this ion is colourless. Onward from Copper a new octet is built up of which Cuprous Copper is the first member, giving rise to a series of elements closely resembling the elements in the first two short series.

The stable complex of the Cuprous ion may be represented by the formula (2.8.8.8.2.) where the numbers within the brackets refer to the numbers of electrons in the successive shells. Around this as a basis the new octet is built up as we proceed onwards through the series. Furthermore, inasmuch as the metallic ions following Copper in this series of elements all possess this formula, having parted with their outside electrons, we should expect them to be colourless, in analogy with the Cuprous ion. When the final member of the series, Krypton, is reached, the electrons forming the shells 8, 2, and the newly completed shell of 8, take their places in the new stable shell of 18, so that the electronic formula of Krypton may be written (2.8.8.18.) after Langmuir.

Let us now return to the coloured ions of the series. There can be little doubt that these ions owe their property of absorbing light in the visible part of the spectrum to the electrons in the subsidiary shell. Colour in this series commences abruptly with the Titanic iron, which contains one electron Cuprous ion in which the subsidiary shell has completed an octet. Further evidence on this point is furnished by the substance Calcium subchloride CaCl,[8] which exists in the form of red crystals. The substance is unstable in solution, but in accordance with the prevailing views on crystal structure, we may regard the ions as preserving their identity within the crystal. The electronic structure of the *Ca' ion* would be given by (2.8.8.1.),' thus corresponding to the Titanic ion (2.8.8.1)''' in electronic arrangement, and as we should expect by analogy, it is coloured. The single outside electron in the case of the Ca' ion is held so loosely that it is lost in solution, forming stable Ca'' ions. The single outside electron in the Titanic ion is however more strongly held by reason of the greater nuclear charge existing on this ion, so that it is stable in solution.

[8] *Zeit. Electrochem.* (1902), 8, *p.* 757.

It thus appears that after Titanium has been passed the tendency of the component electrons of the outer shell to build up an octet gradually disappears. We see it remaining in Titanium, Vanadium, Chromium and Manganese in compounds where the highest or the group valency is exhibited, as in the Titanates, Vanadates, Chromates and Permanganates, all of which can be built up on the simple cubical system, with the help of Langmuir's idea of covalences.[4] For these elements, however, the alternative arrangement outlined above must be assumed in order to account for the compounds in which lower valencies are exhibited, and for this reason the elements may be termed variable elements. The electrochemical quality of a given atom in the two short series is determined by the number of electrons it possesses in its outer shell, the shell being also responsible for the valency relations. In the case of the variable and transition elements of the first long series, however, the outer shell is occupied by the three valency electrons and their electrochemical properties may in a general way be said to approximate to those of Aluminium, which they resemble in this point of structure.

The building up of the subsidiary shell is not attended by any marked change of chemical character as it proceeds, because it is not the outermost part of the atom, existing as it does inside the ring of three valency electrons and is therefore not directly responsible for the electrochemical properties. Nevertheless the stability of this form of electronic arrangement increases as the number of electrons in the subsidiary shell increases, giving rise to a gradual increase in the metallic properties as we proceed towards Nickel.

The fact that Nickel does not give a stable

[4] *Langmuir: Jour. Am. Chem. Soc.* (1919), 41, 1543.

The term covalence indicates the number of pairs of electrons which any given atom shares with its adjacent atoms.

series of trivalent salts may be ascribed to the strong tendency for one of the 3 outer valency electrons to be drawn into the subsidiary shell and thus complete a stable shell of eight. This tendency is vanishingly small in the earlier members, for in the case of Iron all three, and in the case of Cobalt two, of the valency electrons would have to be absorbed by the subsidiary shell, to produce the octet, a task to which the nuclear charge is presumably unequal. In the case of Nickelous ions, the octet formed is probably in an unstable state, a fact to which we can ascribe its colour. When we come to the next element, Copper, the nuclear charge has increased by one unit, and with it the stability of the completed subsidiary shell, while the colour of the Cupric ion is due, as stated before, to the loose electron held outside this stable shell.

The same variability of structure is exhibited by the metals corresponding to the above in the next long series, with the exception that Zirconium, which would be the first member of the variable group, appears to adhere strictly to the octet arrangement, and to give no compounds in which it exhibits a valency lower than that of the typical group valency of 4. Its compounds are colourless.

The second member of the group, Niobium, shows marked trivalent properties, e.g., it forms a violet crystalline trichloride. Molybdenum gives both a dichloride and a trichloride, the former being yellow and the latter red.

The chlorides of the members of the variable and transition elements of the second long series are as follows:

Silver with which the subsidiary octet is completed gives only ions analogous in structure to the colourless Cuprous ion.

There is a tendency in this group of coloured elements for a fourth electron to come into the outer sphere of valency electrons, giving rise to such compounds as $RuCl_4$ and $PdCl_4$. All these Tetravalent salts are coloured.

We have seen above from chemical considerations that it is necessary to postulate a variable electronic structure for certain of the elements occurring towards the centre of the first two long series. This alternative structure consists in building up a subsidiary ring of electrons whose stability increases as the number of electrons it contains approaches 8. Furthermore, the subsidiary ring has been seen to be closely connected with the colour of the cations in solution or crystals. It is therefore significant that when we come to the third and longest series of 32 elements, the above principles still hold with slight modification.

The fortunate work of Moseley[5] enables us to predict with certainty the exact number of the Rare Earth elements. This being so, it can be definitely asserted that there are 16 Rare Earth elements, beginning with Lanthanum and ending with Lutecium. The similarity of properties shown by these among themselves, as well as their trivalency, reminds us of the similarity exhibited by the seven variable elements in the two preceding long series. Again, the fact that nearly all the Rare Earth metals

[5] *Moseley*: *Phil. Mag.* (1914), *VI.*, 27, 703. *Soddy*: *Ann. Rep. Chem. Soc.* (1914), *XI.*, 278. *Langmuir*: *Am. Chem. Jour.* (1919), 41, *p.* 874.

TABLE IV.

Trivalent Salts	Colour	Divalent Salts	Colour
$NbCl_3$	Violet	$MoCl_2$	Yellow
$MoCl_3$	Red		
$RuCl_3$	Orange Yellow	$RuCl_2$	Blue
$RhCl_3$	Dark Red		
($PdCl_3$	Red)	$PdCl_2$	Garnet Red

give strongly coloured ions in solution encourages us to look for an analogous explanation of their similarity and colour.

If we consider the elements Cerium to Platinum as variable elements, we can write them in three rows of seven elements under the seven variable elements of the two previous series. The element Lanthanum finds its place in the Aluminium column. When this is done it will be seen that the members of the Rare Earth group, giving colourless ions, are all segregated. Lanthanum gives colourless ions and comes under the colourless elements of the Aluminium group. The elements Cerium, Terbium and Lutecium occurring in the first group of the Rare Earth block, and the elements Gadolinium and Ytterbium occurring in the last group. are the only Rare Earth elements giving colourless ions. It will be seen that those two groups are really adjacent.

As to the reason why the variable elements of the third long series should be so numerous and occur in three groups of 7, analogous to the single groups of 7 in the preceding long series, no definite answer can be given. Such a question is intimately bound up with the mechanics of stability of the atom. It would appear that in this long series the subsidiary shell, after the first seven electrons have been added, duplicates itself instead of completing the octet and finally adds a third layer of seven electrons before commencing a fresh external octet and finishing the series in the normal way. It will be observed that in the case of Platinum there are 3 completed subsidiary rings of 7 electrons and 3 valency electrons. The inactivity of Platinum in the metallic state may be due to the absorption of these three electrons to produce three stable octets, giving a structure analogous to the Rare Gases of Group O.

The advantages of this arrangement of the Rare Earth elements in the Periodic Classification are manifest when we come to consider other physical properties of the atoms. Firstly, it puts the Rare Earth elements in a compact group under the elements to which they are most strongly analogous in chemical properties. Secondly, a rectangle can be drawn round the variable elements (including Cu, Ag, Au and Zr) which includes all the elements giving coloured ions. All these elements (excluding Cu, Ag, Au and Zr) are paramagnetic, most of them strongly so especially at high temperatures.[6] Gadolinium is probably next after iron, Cobalt and Nickel in magnetic properties; all the elements of the Rare Earths, whose paramagnetism has been measured, have a much greater susceptibility than Manganese. Values of the susceptibility, taken from Landolt Bornstein Tabellen, are included in the Periodic Table given. Of the elements to the right of the rectangle, all except Tin, which is feebly paramagnetic, are diamagnetic. Of the elements to the left, some are feebly paramagnetic and others diamagnetic.

Again[7] if we consider the elements in the Periodic Classification given, from the point of view of the oscillation frequencies[8] it will be seen that the elements within the rectangle maintain a constant high value for any given series, the elements on either side of the rectangle dropping abruptly to very much smaller values. So far as the evidence goes, the same may be said for the latent heats of evaporation[9] per grammolecule. The above data, where known, are included in the Periodic Table, as also are the compressibilities.[10] In the case of

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[6] *It would seem that high magnetic susceptibility like colour is dependent upon the presence of the subsidiary ring in the atom in an incomplete form (i.e., containing less than 8 electrons). In the case of Cu, Ag and Au, which cannot be considered variable in the sense adopted above, the subsidiary ring of 8 is complete, while as before stated, Zr does not exhibit variability.*

[7] *The Author wishes to express his indebtedness to Dr. E. K. Rideal for drawing his attention to the important relations mentioned in this paragraph, and also for much helpful criticism of the whole paper.*

[8] *W. C. McC. Lewis, Physical Chemistry, Vol. III., p.* 61.

Rideal, Proc. Camb. Phil. Soc. XX. (1921), *p.* 298.

[10] *T. W. Richards, Zeit. Phys. Chem.* (1908), 61, *p.* 183.

this latter property, it will be seen that the elements within the rectangle are conspicuous for their low compressibilities, there *being a considerable increase—200-300 %—* immediately we leave it.

It is highly probable that the above physical properties depend on the external field *of force of the atom, and their tendency to* a constant value, among the variable elements of a given series of the Periodic Table, would therefore indicate that the external fields of force of the atoms of these elements approximate to a constant value. That these elements can all lose three electrons in ion formation is a further point in favour of this deduction.

In passing, hypothetically, from one element to that of the next highest atomic number, the nuclear charge is increased by one unit, and at the same time an electron is added *to the outside of the atom.* It must be supposed that in the case of the variable elements this produces but a very small effect on the external field of the atom, i.e., the extra unit of nuclear charge and the electron practically neutralise each other.—On the other hand it has been mentioned that the variable elements in their highest state of oxidation resemble the typical members of the short series, e.g., Manganese imitates Chlorine in Permanganates; the tendency to cubic symmetry is therefore not entirely absent in the structure of these atoms.—It was shown, however, that a more stable alternative arrangement was probable,—the subsidiary shell—in the case of the tri- and di-valent salts of these elements. It now appears that these elements must possess this alternative structure in the free state, for we should expect that if free Manganese, for example, possessed the cubic symmetry of the free Chlorine molecule, it would resemble it in physical properties. This is obviously not the case as all the variable elements are metallic in the free state and quite different in physical properties from the typical non-metals of the short series. The constancy of the external fields of these variable elements can, however, be connected with the presence of the subsidiary shell in their free atoms. We have already seen that as we add electrons to this subsidiary shell, in passing from one element to the next in the series, the electrochemical nature of the cations in solution is not greatly affected. It is therefore most likely for this reason, and also from what has been said above, that in passing from one variable element to the next, the electron is added to the subsidiary shell, and approximately neutralises the effect of the added unit of nuclear *charge on the* external field of the atom.

The *electronic* formulae of the free atoms of the elements of the first *long series* can now be written as follows, the kernel being placed in brackets and the valency electrons outside.

Ar (2.8.8.)		Zn (2.8.8.8.2.) 2
K (2.8.8.) 1		Ga (2.8.8.8.2) 3
Ca (2.8.8.) 2		Ge (2.8.8.8.2) 4
Sc (2.8.8.) 3		As (2.8.8.8.2.) 5
Ti (2.8.8.1.) 3	Variable Elements giving coloured Ions.	Se (2.8.8.8.2.) 6
V (2.8.8.2.) 3		Br (2.8.8.8.2.) 7
Cr (2.8.8.3.) 3		Kr (2.8.8.18.)
Mn (2.8.8.4.) 3		
Fe (2.8.8.5.) 3		
Co (2.8.8.6.) 3		
Ni (2.8.8.7.) 3		
Cu (2.8.8.8.) 3		

Similar formulae can be written for the other long series. In the Rare Earth series as mentioned, however, the subsidiary shell can contain up to 21 electrons in the case of Platinum and 22 in the case of trivalent Gold. Monovalent gold, the first member of the new octet, is represented by the electronic formula (2.8.8.18.18.8.8.8.) 1, the kernel of which is common to all the subsequent members of this long series.

NOTE.—After this paper was written the attention of the author was drawn to a very similar form of the Periodic table, given by Professor Stewart in the latest edition of his book, "The Recent Advances of Physical and Inorganic Chemistry."

A HIGH PRESSURE DUE TO ADSORPTION.

By William D. Harkins and D. T. Ewing.
Continued from Dec. 30th issue.

3. Relation of the Total Apparent Pore Volume to the Compressibility of the Liquids.

The most remarkable feature of Tables I. and II. is that the apparent density and total pore (capillary and micropore) volume depend upon the liquid in which the charcoal is immersed, and in general both increase markedly either as the compressibility increases or the viscosity decreases. This suggests alternative hypotheses, which lead to practically opposite conclusions with respect to the density. The first of these, supported also by the later data obtained by Mr. Monroe, is that the *liquid in the micropores is very highly compressed by adsorption, and that this compression is greater, the greater the compressibility of the liquid in bulk.*[11] That the molecules of the liquid should be drawn closer to the atoms in the surface layers and edges, seems to be the normal supposition when the magnitudes of the adhesional forces are taken into account, since such forces are much more intense than those which hold the molecules of liquid together. While this may not have been proved directly, it is evident that the energy of adsorption for a charcoal surface is very much higher than the energy of cohesion in water or in an organic liquid, since the energy of vaporization of such an adsorbed liquid is very much greater than that of the liquid itself. In addition to this the work of this laboratory has shown that even on a mercury surface the energy of adhesion for these liquids is usually three or more times that in the pure liquids. It should be noted that this factor is altogether too low to express the relations at a carbon surface.

However, the compressive effect need not vary directly as the compressibility of the liquid in bulk, since the liquid is not compressed iso-tropically. A second factor which might be expected to cause a divergence is that the force of adhesion is not the same for all of the liquids. When these factors are considered, the agreement in the order seems very remarkable.[12]

When the highly evacuated lump of charcoal is put under the surface of a liquid, the latter enters the capillaries or macropores, and these in the charcoals which preserve to a considerable extent the original structure of the shell, have diameters of the order of 0.012 mm. in diameter, so they are filled quickly, provided they are in direct communication with the liquid, but the micropores are filled much more slowly. In the capillaries the driving force of penetration is the surface tension, while the retarding force is the viscosity, and the speed of penetration should vary as the ratio γ/η where γ represents the surface tension and η the viscosity. That this is true has recently been shown by Washburn. It might be thought that the differences in the volumes of the liquids which penetrate the charcoal are due to incomplete penetration by some of the liquids, especially in the cases of water and propyl alcohol, but there is *no parallelism* between the values of the ratio $(\ /\ )^{1/2}$ and the volume of liquid which penetrates. However, as the pores become finer the influence of the viscosity may become predominant, especially when the liquid, after passing through a part of a narrow pore, enters into a region where its cross section becomes enlarged.

While a consideration of the relation between the pore volumes and the viscosities of the liquids as presented in Table I., shows that the data would in general support the idea that the effects might be due to different penetrations of the charcoal by the different liquids, the least viscous penetrating most; it will be seen that the propyl alcohol is very badly out of order in this sense, though in exactly the order prescribed by the compressibility hypothesis. Since several other liquids have been found by Mr. Monroe which are also out of order with respect to viscosity, but in the order of the compressions, it seems evident that at least the greater part of the observed differences in volume is due to the compression of the liquid, though the viscosity may exert a minor influence upon them.

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[10] All of these data refer to the lump density.

[11] The second hypothesis suggested, that the most viscous liquids penetrate least, does not seem to be in good agreement with the experimental data, as indicated later in the text.

[12] This indicates that the variation of the adhesive force with a change from water to various organic liquids, is not very great. This agrees with the conclusion of Lamb and Coolidge (Ref. 4).

The apparent densities in water of the coconut-shell charcoals as given above are 1.843 and 1.863; that of the similar charcoal used by Titoff, 1.86; by Baerwald, 1.92; and by Miss Homfray, 1.66; by Cude and Hulett, 1.854 on 18- to 20- mesh, and 1.900 for the same charcoal of 100- to 200-mesh (per inch). Kerosene gave very nearly the same apparent density with charcoal E 602 as benzene, or about 2.008. With this may be compared the data obtained by Chaney and Apmann, who determined the apparent density in kerosene of 30 charcoals, and found that the lower the value of this quantity, the lower in general is the service time. Thus densities in kerosene of 2.14, 2.17, 2.11, 2.11, 2.08, 2.02 and 2.02, correspond respectively to service times of 68, 64, 60, 59, 57, 55, and 54 minutes; while at the other extreme, densities of 1.98, 1.86, 1.87, 1.66, 1.63, and 1.66, correspond to service times of 33.1, 30.7, 27.6, 17.8, 8.0, and 4.3 minutes. Their data are in good agreement with the value found here, since a density of 2.02 in kerosene, the value corresponding to Table I., was found by them to correspond to a service time of 41 to about 49 minutes, which is not very far from that given in Table I.

However, there is not such good agreement with the data obtained by Cude and Hulett,[6] as is shown in Table III.

TABLE III.

APPARENT DENSITIES OF TWO SPECIMENS OF COCONUT-SHELL CHARCOAL.

Liquid	Cude and Hulett Charcoal A 909 (18- to 20-mesh).	This investigation Charcoal E 602 (10- to 14-Mesh
Water	1.854 ...	1.843
Benzene	1.797 ...	2.008
Carbon disulfide	1.915 ...	2.067

The discrepancy in the sign of the difference exists only in the single case of benzene. This liquid exhibited the same relative order in our investigations of two other charcoals, A and No. 1, so its position in the series can hardly be an accident, especially as many determinations were run for charcoal E 602. Some factor was evidently present in the work of Cude and Hulett[6], which was absent in our own. It is possible that the discrepancy is due to the extent of the outgassing, which was more thorough in our work, since we happened to have a very much more rapid vacuum pump, used a large connecting tube in place of their capillary, and outgassed for

It is of interest to note that in the more active charcoals the apparent volume of ethyl ether, minus the volume of water, in the pore of 1 cc. of charcoal ($-\Delta v$),—which shows how much more the ether is compressed than the water—is nearly constant and about 0.055 cc., as is shown by Table IV.

TABLE IV.

COMPRESSION OF ETHER IN CUBIC CENTIMETERS PER CUBIC CENTIMETER OF CHARCOAL, MINUS THE COMPRESSION OF WATER ($-\Delta v$).

Charcoal	Service time, minutes.	$-\Delta v$
Rankinite A	42.9 ...	0.052
Active carbon 4	40.9 ...	0.067
Charcoal 1	32.0 ...	0.053
E 621	27.0 ...	0.051
Active carbon 1	19.0 ...	0.043
Active carbon 3	1.10 ...	0.018
Cedar wood charcoal ...	0.0 ...	0.008
Beechwood charcoal ...	0.0 ...	0.004

Of these charcoals the last, made from beechwood, was the poorest adsorbent for chloropicrin as determined by the regular test. It is apparent that the value of $-\Delta v$ is nearly constant as the service time decreases from 47 to 27 minutes, but falls very rapidly as the service time decreases to 19 and 11 minutes, while the charcoals which give practically a zero service time, give also a very small value for the compression decrement ($-\Delta v$).

4. THE HEAT OF ADSORPTION OF LIQUIDS IN CHARCOAL.

When lumps of outgassed charcoal are dropped into a liquid, or when a liquid is poured into a tube which already contains the charcoal, the liquid penetrates the charcoal, with the result that the carbon surface of the pores disappears, and a carbon-liquid interface takes its place. In this process heat is developed, and this may be specified as the heat of immersion, of adsorption ($-Q$), or of absorption. Thus 1 g. of bone charcoal, which had not been outgassed, gave off 18.5 calories when immersed in water, while the same weight of fuller's earth in the same liquid, gave 32 calories. The data of Lamb and Coolidge on the heat of adsorption of vapours by charcoal indicate that the heat of immersion of a typical coconut-shell charcoal in carbon disulfide is of the order of 35 calories per gram.

(To be continued)

NOTES ON BOOKS.

The Manufacture and Use of Explosives, with Notes on their Characteristics and Testing, for Chemists, Ordnance Officers, Mining Engineers and Students. By R. C. Farmer, O.B.E., D.Sc. and Ph.D., with a foreword by Sir Robert Robertson, K.B.E., F.R.S. 116 pp., illustrated. London: Sir Isaac Pitman & Sons, Ltd., Parker St., Kingsway, W.C.2. Price 2s. 6d.

The foreword by Sir Robert Robertson at the commencement of the book stamps it with unquestionable authority. Dr. Farmer's experience at Woolwich before the war and his subsequent work in the Department of Explosives Supply to the Ministry of Munitions place him in a unique position for dealing with this important subject.

It is pleasing to think that the experience gained in the manufacture and use of explosives during the war can now be put to practical use for industrial purposes in mining, tunnelling and agriculture. The author in his preface refers to the universal wish that these uses may entirely supersede the destructive application of explosives, and he quotes the words of His Majesty King George V., in opening the War Museum in 1920, when he said:—

"We hope and pray that, realising all that we have done and suffered, future generations will look back upon the war, its instruments and organisation, as belonging to a dead past."

It is the author's aim to so distribute the knowledge gained in the manufacture of explosives during the war that it may be now put to peaceful uses. Although a certain amount of chemical knowledge is necessary to follow the preparation of explosives, there is nothing in the book that will prejudice the author's descriptions.

In the first 14 pages, after a few words concerning the discovery of gunpowder and explosives generally, a short description is given of various military explosives, with drawings and descriptions of shells and bombs. This is followed by details of the properties and tests of explosives and an account of the chemical nature of gunpowder, nitro-cellulose, picric acid, T.N.T. and various other nitro compounds.

Chapter XI. deals with detonators, mercury fulminate, and other detonating compounds. The final chapters are devoted to a brief description of fireworks. At the end of the little book there is a good biblio-

Fuel and Lubricating Oils for Diesel Engines. By W. Schenker. 114 pp. Illustrated. Constable & Co., Ltd., 10-12, Orange St., London, 1921. Price 10s. net.

The book is mainly intended for owners and engineers in charge of Diesel engines. Within the last few years there has been a continual increase in the number of fuels found suitable for these engines. Special attention has been devoted to oil fuels, and a section has been given to the subject of lubricating oils. This is, of course, necessary, as the lubrication of an engine is as essential as is the oil used for its fuel; the methods of testing described will of necessity apply to both. The author certainly commences at the beginning of the subject, by going back to a general description of the early discovery of petroleum oils, and photographic reproductions are given of the oil wells and derricks at Baku and other localities. Good descriptions are given of the manufacture of tar oils, their composition and analysis.

In the middle of the book there are some tables of the analyses of fuels from tests made by the Swiss Federal Fuel Testing Laboratories at Zurich, which are very valuable. The illustrations are good, and the book is one that will certainly be sought after by engineers and works departments interested in Diesel engines.

At the end of the book tables are given for the conversion of degrees Centigrade into degrees Fahrenheit, and other useful dictionary and an encyclopædia.

A Dictionary of Chemical Terms. By James F. Couch. D. van Nostrand Co., 8, Warren St., New York. iv. plus 204 pp.

The need for a dictionary of this kind is very great, on account of the continual introduction of new definitions and terms. The aim of the author has been to produce something between a standard English dictinary and an encyclopædia.

We notice that under the heading of "Rays" the various forms of radiation that have played such a prominent part in physical science during the last few years are described with unusual accuracy.

The book is well printed and the descriptions, while brief, are very inclusive, and it has the advantage of being of small size

Oils, Fats and Fuels. By Thomas Hull. Blackie & Sons, Ltd., 50, Old Bailey, London, Glasgow and Bombay. viii. plus 143 pp. Price 3s. 6d. net.

This book is intended for the use of students attending technical schools and classes, and the aim of the author has been to give as much general information upon the subjects as can be included in a small book. As far as possible, chemical formulæ have been omitted, but good practical information is given. The various processes described are well illustrated by the woodcuts and line blocks, and quite a number of half-tone plates are produced showing the method of gathering turpentine, the oil wells of Los Angeles, petroleum stills and other sundries.

This method of giving practical illustrations of the working of the various processes will undoubtedly be appreciated by teachers, as it gives students an intelligent idea of the methods of gathering and producing oils and fats.

The latter half of the book is occupied with fuels, the preparation of wood charcoal and coke, and a description of the present-day use of liquid fuels.

Each chapter of the book is followed by a series of questions upon the subjects that have been dealt with, for which answers are given in an appendix at the end.

Monographs of Physics. Edited by Sir J. J. Thomson, O.M., F.R.S., and Frank Horton, D.Sc.

(A.) *Rays of Positive Electricity and their Application to Chemical Analysis.* By Sir J. J. Thomson, O.M., F.R.S. Second Edition. x. plus 237 pp. Illustrated. Longmans Green & Co., London. Price 16s. net.

This work will be found of great value to those who are interested in the rapid progress of physical science. The author, in his preface, refers to the hope that he expressed on the publication of the first edition, that the positive rays would be found of service in connexion with important chemical problems. This hope has been fulfilled by the researches of Aston and others on the determination of atomic weights and the detection of isotopes. The author expresses his conviction that as yet we are only beginning a harvest of results which will elucidate the processes of

The book is fully illustrated with carefully-made diagrams of photographs which are familiar to most of us who have followed the remarkable researches carried out by Sir J. J. Thomson at the Cavendish Laboratory and the Royal Institution.

A work of this kind, which is really a publication by the author of those researches for which his name will always be famous, is outside of the scope of criticism. We are quite sure that the whole of the scientific world will be grateful to the author for having found time to collect together data that would otherwise be widely distributed and not always accessible.

At the end of the book there is given a large number of those remarkable photographs of the tracks of the Positive Rays and atomic matter which have brought those material particles, of which the chemical atom is built, within the sphere of vision.

(B.) *The Emission of Electricty from Hot Bodies.* By O. W. Richardson, F.R.S. Second Edition. Illustrated. Longmans, Green & Co. Price 16s. net.

Professor Richardson, in his second edition of this valuable monograph, has endeavoured to bring the matter up-to-date and at the same time to correct some errors that unavoidably appeared in the first edition.

Reference is made to the rapid progress that has been effected within the last few years in the technical application of the emission of electrons from hot bodies, and he points out that these practical applications have become so numerous and important that it is not possible to include them in a work of this size. The author devotes himself to the discussion of the theory connected with the emission of electrons, the effects produced by gases and other fundamental problems.

An important chapter is given up to the emission of positive ions by hot metals, and the subject is carried back to experiments made by Dr. Guthrie in 1873, and a brief description is given of the rapid development that followed.

Reference is made to the observation by Edison of a fact which was noticed in the early days of incandescent lamp manufacture. Edison found that if an independent electrode was mounted between the two

it and the positive terminal—but not between it and the negative terminal. This observation was followed by a great number of experiments by Preece, Fleming Crookes, Elster, Geitel, and others, and has culminated in the transmission of speech from one side of the world to the other. These results are now familiar to everyone who reads the daily papers. By the great mass of people they are regarded merely as wonders of science, but the mass of experimental data given in Professor Richardson's book shows that these remarkable achievements have been attained only by painstaking study and ungrudged labour.

(Synthetic Organic Chemicals.)

We have received from the Research Laboratory of the Eastman Kodak Co., of Rochester, New York, their latest list of synthetic organic chemicals, containing the names of over 1,200 compounds now in stock. The Research Laboratory was originated about three years ago with the object of ensuring the independence of the country with regard to these essential materials. The progress of the laboratory has been very rapid, and the stock of products is being continually increased.

In the list the standard price is given for each product, according to the metric system, in quantities of from 5 to 1,000 grammes. The list is accompanied by a small booklet by Dr. C. E. Kenneth Mees and H. T. Clarke.

As is known to most members of the photographic industry, Dr. Mees left this country some few years ago to take up the position of Director of Research at Rochester, and the pamphlet in question is a highly interesting booklet giving the progress of the research laboratories under his and Mr. Clarke's direction. It is fully illustrated with photographic reproductions showing the actual laboratories and the apparatus used therein.

We sincerely congratulate the authors on the success of their work, which will be for the benefit of chemists generally.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (B.A.R.P.).

The above association has recently been incorporated under the Companies Acts.

The object is to advance the subject of Radiology and Physiotherapy under the direct control of the medical profession,

This is a step that has been contemplated for some time past, and it is one that cannot fail to be to the public benefit, the application of the recent advances in the science of radiology to the needs of the medical profession has been of enormous value, and it is fitting that a power which may be either a very great gain or a very great danger should be entirely under the control of a recognised public body.

We note that the names of the original subscribers are those of the leading members of the profession, and wish the Association every success.

THE INSTITUTION OF ELECTRICAL ENGINEERS. COMMEMORATION MEETING.

For the purpose of commemorating the first meeting of the Society of Telegraph Engineers, which was held on February 28th, 1872, the Council of the Institution of Electrical Engineers (originally the Society of Telegraph Engineers) are arranging for the following Institution functions to be held on dates approximately corresponding to that of the original meeting:—

Tuesday, February 21st, at 4 p.m.—Popular Lecture (admission by ticket, a limited number of seats being reserved for guests), by Professor J. A. Fleming, F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering."

Tuesday, February 21st, at 7 p.m. (for 7.30 p.m.).—Annual Dinner at the Hotel Cecil.

Wednesday, February 22nd, at 8.30 p.m.—Professor Fleming will repeat his Lecture of the previous day.

Thursday, February 23rd, from 4 to 6 p.m. and from 8 to 10 p.m.—A number of members of the Institution and others closely connected with the early

development of Electrical Engineering will give short discourses on their reminiscences and experiences during the early history of the Electricity Supply Industry. The speakers will deal both with matters of scientific and technical interest and also with the effect of legislative action on the progress of the industry.

This is only a preliminary announcement, and full particulars will be published later.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER 1922.
FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

January 20.—Sir James Dewar, LL.D., D.Sc., F.R.S., M.R.I., Fullerian Prof. of Chemistry. —"Soap Films and Molecular Forces."

January 27.—Viscount Burnham, J.P.—"Journalism."

February 3.—Lieut.-Colonel Sir Francis Younghusband, K.C.S.I., K.C.I.E.—"The Mount Everest Expedition."

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—"The Teeth of the Nation."

February 17.—Dr. S. M. Watson, M.Sc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—"History of the Mammalian Ear."

February 24.—John Joly, D.Sc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot-Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., F.R.S., M.R.I., Prof. of Chemistry University of London. —"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I. —"Evolution of the Elements."

ROYAL INSTITUTION.

On Tuesday next (Jan. 17) at 3 o'clock Dr. F. H. A. Marshall begins a course of two Lectures at the Royal Institution on "Physiology as Applied to Agriculture"; on Thursday (Jan. 19) Mr. Seton Gordon gives the first of two Lectures on (1) "Mountain Birds of Scotland," (2) "Sea Birds and Seals"; and on Saturday (Jan. 21) Dr. Charles Macpherson, Organist of St. Paul's Cathedral, commences a course of two Lectures with musical illustrations on "The Evolution of Organ Music." The Friday Evening Discourse on Jan. 20 will be delivered by Sir James Dewar on "Soap Films and Molecular Forces," and on Jan. 27 by Viscount Burnham on "Journalism."

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the Editor.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3223.

GRANTS TO UNIVERSITIES.

IMPORTANT LETTER.

An important letter has been addressed to the Prime Minister by the Universities of Birmingham, Durham, Leeds, Liverpool, Manchester, and Sheffield, and a similar one has been sent by the Universities of Oxford, Cambridge, London, Bristol, Wales, Glasgow and Aberdeen.

Realising the importance of the matter and the great danger of reducing the grants made by the Government to Universities at the present juncture, we venture to reproduce the full text of the communication.

To the Right Honourable David Lloyd George, M.P.

SIR,

On behalf of the Sister Universities of Birmingham, Durham, Leeds, Liverpool, Manchester and Sheffield, which provide opportunities of University education for twelve thousand students, the great majority of whom live in the Midlands and North, we beg leave to submit to you the following considerations against any reduction being made in the amount of the grants paid by Government towards the cost of the work of Universities and University Colleges in Great Britain. In doing so, we desire to express our obligation to His Majesty's Government for the notable help given to the Universities tofards their support during recent years.

2. Recognising the need for the utmost economy in public expenditure at the present time, our Universities have restricted their outlay within the narrowest limits consistent with their continued educational efficiency. To this end personal sacrifices are being made, and many developments, in themselves not only desirable but urgently needed, have been foregone. But we are persuaded that the grants now made to us by Government are at the lowest level at which the due discharge of our duties to the nation can be guaranteed, and that any retrenchment would be hurtful to public interests and wasteful of outlay already made.

3. Shortly after the outbreak of war in 1914, the Committee on Public Retrenchment contemplated the suspension of all grants paid by Government to the Universities and University Colleges. A memorandum was forthwith submitted to that Committee on August 26th, 1915, by the Vice-Chancellors of the sister Universities of Manchester, Liverpool, Leeds and Sheffield. The Committee on Public Retrenchment did not recommend the withdrawal of the University grants. In consequence, the Universities were enabled during the continuance of the war to render to the nation services previously unforeseen, and subsequently acknowledged by the Government as of vital importance.

Mr. Austen Chamberlain, referring to this subject in Birmingham, said that "there was not an aspect of national life in which the acquired experience of the Universities did not render assistance without which it was difficult to say how we could have won the victory which eventually crowned our efforts."

It is certain that, if the means are not withheld from them, the British Universities are in a positon to render not less signal service to the nation during the coming years of peace.

4. The Universities, now organised upon a popular basis, give opportunity to the young men and women of the rising generation from every type of home. The University in England and in Wales has become (as it has long been in Scotland) representative of the whole people.

The Universities are the recruiting and training grounds for the great professions and for the pubic services, local and central. The Sacred Ministry, Medicine and Dentistry, the Teaching Profession, the Legal Profession, as well as the administrative services, rely mainly upon the Universities for the maintenance of their high standards.

The Universities train both workers and leaders for industry. They educate chemists, physicists, steel experts, civil, mechanical and electrical engineers, architects, farmers, colliery managers, metallurgists, textile managers, gas engineers, dyers and leather trade experts.

The Universities advance science. They are the chief centres of research. Their work has helped to enrich British industry and commerce and has added millions to the national wealth.

The Universities extend the frontiers of knowledge in all other departments of study—in history, with its bearing on politics; in economics; in international law; in psychology, which throws light upon movements of opinion; and in languages, the study of which meets many Imperial needs.

The Universities, on whose behalf we write, are open on equal terms and in all respects to men and to women. Aid from public funds has alone made it possible for them to offer the opportunity of a University education at a fee which has kept them accessible to applicants of promise but of slender means.

By means of student self-government and by the corporate life in residential halls, the Universities train men and women for the responsibilities of citizens, whether as leaders or in submission to the common will.

In fact, the Universities hold the keys of the future, for they supply practical needs of the Empire which cannot be met from any other source.

5. The funds which they now command are already inadequate for the needs of the British Universities.

(a) Almost all of the Sister Universities have sustained a heavy loss on the working of the last academic year.

(b) All are short of what should be spent annually, even upon the least adequate scale, in order to attract a succession of the best recruits for the filling of vacancies in the teaching staffs. This deficiency is not less than half a million pounds a year.

(c) All are short of the means of providing for advanced students in general, and for those from Overseas in particular, opportunities of study and research. Failure to meet the requirements of overseas students will weaken the bonds of the Commonwealth.

6. In order to meet their urgent needs our Universities have made every effort of self-help, and in this have been loyally supported by the students and their parents, as well as by private benefactors, by large firms, and by the local authorities of the areas which we serve.

(a) We have practised severe economy in all structural expenditure and in the maintenance and equipment of laboratories.

(b) We have raised the fees for courses of study and for examination by considerable amounts. This can only be justified as an emergency measure. About a third of the total income of our Universities comes from students' fees.

(c) We have collected from private benefactors during the last three years £1,175,000 for the maintenance and, where necessary, the development of the Universities.

(d) The local authorities of our areas have supported us by increasing their annual grants from £74,268 to £135,808. (Detailed figures are given in the Appendix).

The Government urged us to make the efforts which have led to this measure of success by encouraging us to hope that what we raised locally would be met by a corresponding increase in Government Grants.

7. In other countries, with which Britain must endeavour to hold her own, renewed exorts have been made since the War to strengthen the resources of Universities. The latter are held by the Governments and electorates concerned to be indispensable factors in the strength of the nation and are reckoned among the chief sources of its intellectual, administrative, and commercial power.

In Germany the Governments have shown that they attach the highest importance to Universities as centres of training for the professions, for responsible posts in industry and commerce, for scientific expert knowledge, and for the public services. They regard the Universities as homes of research for the advancement of knowledge and its application to national policy and to human welfare. Furthermore, they encourage and aid the Universities to provide wider opportunities of adult education for men and women who cannot reside at them for full-time courses of study.

In the United States, the generous endowment of Universities puts Britain to the blush. Gifts to Universities, whether they are maintained from corporate funds or by the State, are a conspicuous feature of modern American life. It is there felt that, in whatever else economy must be practised, Universities should be generously maintained, and that expenditure upon them from public funds is not only one of

the most profitable of investments, but an indispensable guarantee of national welfare. Gifts to Universities, up to 15 per cent. of the donor's income, are by Federal Law exempt from Federal Income Tax. The liberality of private benefactors is thus encouraged by a tempting concession from public funds.

In Canada, not only the great incorporated Universities like McGill, but the State Universities, receive increasing subsidies *from public funds and gifts from private* benefactors. Canadians feel that they cannot afford to lag behind the United States in University development, and they would regard with concern any failure on the part of Britain to maintain her Universities in high and increasing efficiency.

8. But retrenchment in the present grants would threaten the Universities with debility, and would check their growth as democratic institutions. Their work is part of the life insurance of the nation. To fail to keep up the premiums would, we submit, be unwise. A refusal to spend upon Universities what University work requires would discredit Britain in the eyes of other peoples, not least in the eyes of the sister nations of the Commonwealth, and would disconcert and dishearten the most intelligent of our citizens, especially those of the younger generation.

We have the honour to be, Sir,

Your obedient Servants,

C. GRANT ROBERTSON,
Principal of Birmingham University.

DAVID DRUMMOND,
Vice-Chancellor of Durham University.

M. E. SADLER,
Vice-Chancellor of Leeds University.

J. G. ADAMI,
Vice-Chancellor of Liverpool University.

HENRY A. MIERS,
Vice-Chancellor of Manchester University.

W. H. HADOW,
Vice-Chancellor of Sheffield University.

10th December, 1921.

A HIGH PRESSURE DUE TO ADSORPTION.

By WILLIAM D. HARKINS AND D. T. EWING.

Continued from Page 24, January 13 issue.

THE HEAT OF ADSORPTION OF LIQUIDS IN CHARCOAL.

The heat of immersion of a solid whose surface is so nearly plane that its surface energy is essentially equal to that of the same area of a plane surface of the same material, or the heat of adsorption of a liquid on the surface of the solid, may be defined in a corresponding way as the amount of heat liberated ($-Q_a$) when a solid with a surface of this type, and of an area of 1 sq. cm. is immersed in a liquid in such a way as not to increase materially the area of the surface of the liquid. In this process the surface of the solid would disappear, and in its place would appear the same area of interface solid-liquid. The heat liberated ($-Q_a$) would be equal to the total amount of energy given off in the process when carried out iso-thermally (E_a), and this is equal to the total surface energy of the solid (E_s), minus the total surface energy of the interface (E_i), for 1 sq. cm. of surface. Since the total surface energy is always equal to the free surface energy (γ) plus the latent heat of the surface ($-T\frac{\delta\gamma}{\delta T}=l$), the following equation expresses the value of the heat of adsorption.

$$-Q_a=E_a=E_s-E_i=\gamma_s+l_s-(\gamma_i+l_i)=\gamma_s-T\frac{\delta\gamma_s}{\delta T}-\gamma_i+T\frac{\delta\gamma_i}{\delta T} \quad (1)$$

It is obvious that this equation is also valid for the heat of immersion of a liquid, or for the heat of adsorption of one liquid on the surface of another liquid, so in its more general sense the subscript s refers to the phase whose surface is already developed, but later disappears, giving place to an interface of the same area. The heat liberated on the immersion of a solid has always been found to be a positive quantity, which indicates that the total interfacial energy per unit area is always less, so long as this holds true, than the total surface energy of the solid. That this is not always the correct sign of the effect, at least when only liquids are involved, is shown by the fact that hexane, octane, and carbon tetrachloride have negative heats of immersion in water equal respectively to —0.21, —0.21, —0.26, times 10^{-6} calories

per sq. cm. at 20°, though the heats of immersion of water in these liquids are all positive, 1.4, 1.34 and 1.05 times 10^{-6} calories per sq. cm. Even in the case of two liquids heat is almost always evolved on immersion as the result of the surface energy changes. Thus, for example, the heat of immersion of normal octyl alcohol at 20° in water is 1.28, and of water in octyl alcohol, 2.85, in terms of the units used above.

The heat liberated on adhesion ($-Q_A$), and the total adhesional energy (E_A), are always larger positive (or smaller negative) quantities than those which give the heat liberated on immersion (heat of adsorption), provided the surfaces are plane. The following equation gives the heat of adhesion.

$$-Q_A = E_A = E_s + E_l - E_i = (\gamma_s + l_s) + (\gamma_l + l_l) - (\gamma_i + l_i) \quad (2)$$

These are the same as the heat and energy of approach, since the surfaces of two phases already in existence approach each other and disappear, while an interface, equal in area to that of either surface which disappears, takes their place. The heat of adhesion is 2.6 for water-hexane, 4.0 for water-octyl alcohol, 2.5 for water-carbon tetrachloride, all in 10^{-6} calories per sq. cm. at 20°.

When a liqnid spreads over a solid, the surface of the solid disappears, while an interface of the same area appears. If the solid has a plane surface, then a liquid surface of the same area also appears ; so, provided the liquid layer is not too thin, the following equation holds.

$$-Q_{sp} = E_{sp} = E_s - E_l + E_i) = \gamma_s + l_s - (\gamma_l + l_l) - (\gamma_i + l_i) = E_A - E_c$$

where E represents the energy of surface cohesion of the liquid.

Obviously,

$$-Q_a = E_a = E_c - E_l$$

or the heat liberated by the adsorption of a liquid equals the energy of adhesion minus the surface energy of the liquid. Also

$$-Q_a = E_a = E_{sp} + E_l$$

and

$$E_{sp} = E_A - 2E_l$$

The heat of adsorption of a saturated vapour is

$$-Q_g = (\gamma_s + l_s) - (\gamma_i + l_i) + \lambda v = E_s - E_i + \lambda v$$

where $-Q_g$ is the heat of adsorption of enough vapour to form a liquid in bulk covering the solid surface at constant temperature, and λ is the latent heat absorbed in the vaporization of the liquid per unit volume of vapour. It is assumed here that the area of the surface of the liquid formed is negligible in comparison with the area of the interface which is formed.

While we do not have the values of the above quantities for carbon, they have been determined in this laboratory for the interfaces between mercury and other liquids ; in which case the values for the liquid mercury may be substituted for the values for the solid in the above equations. The heat of adsorption as defined above is thus found to be 3.25 for *iso*-butyl alcohol, 2.60 for *secondary* octyl alcohol, and 3.13 for octane, all in 10^{-6} calories per sq. cm. The heat of spreading of *n*-octyl alcohol on water is about that of *iso*-butyl alcohol on mercury, but that for octane on water is less than half the similar value for mercury.

5. The Area of the Surface Exposed to a Liquid inside One Gram of Charcoal.

That there is anything in a lump of charcoal which corresponds to a plane surface is altogether improbable ; and it is not unlikely that what corresponds to a surface may be molecularly rough, so that it would be impossible to designate any number which would correspond to the area in square centimeters of the surface. However, several estimates of this surface area have been made. Thus Lamb, Wilson and Chaney[8] have estimated the surface in 1 g. of an activated charcoal as 1,000 square meters, Lowry and Hulett[13] obtain the value 200 square meters for a similar charcoal, while A. M. Williams,[14] in developing a new interpolation formula for the adsorption of gases, calculated the surface of the non-activated charcoal used by Miss Homfray as 131 square meters.

The data given in the preceding section of this paper, together with the equations given there, suggest an independent method of determining whether these estimates are of the right order of magnitude to represent what may be called the "apparent surface," which will be defined as the area of the plane surface of the same material

13 Lowry and Hulett, This Journal, 42, 1393-1419 (1920).

14 A. M. Williams, *Proc. Roy. Soc. Edinburgh*, 39, 48-55 (1918).

vhich will give the same heat of immersion ɔr of wetting when wet by the same liquid n bulk. Unfortunately for our purpose the ıeat of adsorption of charcoal has been letermined in none of the liquids given here, so what will be presented here will be nerely illustrative of the method. We will uppose that the heat of immersion of char- :oal in carbon disulfide is as large or larger han the heat of immersion of mercury in ɔctane, which does not seem unreasonable. f we assume that these two heats of immer- ion or of wetting are equal, the heat of im- nersion of one gram of charcoal in carbon lisulfide, 35 calories, would correspond to ın *apparent area* as defined above of about 20 square meters. Since it is practically ertain that the heats of immersion of car- ɔon are higher than those for mercury, this esult would seem to represent a maximum vhich is still too large. The method of alculating the area of the charcoal surface ɔy the use of the capillary equation of Anderson[15] cannot be expected to give any eal correspondence with even such an pparent area, since his equation obviously ɔreaks down completely at the diameters of he micropores which are calculated from he equation. Thus Lowry and Hulett[13], ɔy using his equation, find 1.6×10^{-8} cm. ıs the minimum, and 8.3×10^{-7} cm. as the naximum diameters of the pores in all of he charcoals investigated by them ; and alculations from data obtained in this aboratory give values of the same order but vithout the above minimum. These dimen- ions are of such a small magnitude as to pproach so closely molecular dimensions, hat an equation such as the one cited, leveloped from the relations in a capillary ube of ordinary dimensions, is altogether vithout meaning. However, if the lower imits for the diameter at which it is still alid could be determined, it would be use- ıl in calculating how much of the liquid contained in pores of that and smaller iameters. Experimental work of the heat f immersion of porous solids in liquids was egun in this laboratory several years ago, ut was interrupted. It will be resumed in he coming summer.

6. VOLUME OF THE PORES, AND THE DENSITY OF CHARCOAL.

If either charcoal E 602 or No. 1, for vhich the data are very nearly identical, is taken as a characteristic coconut-shell charcoal, it may be easily seen that if the liquids are compressed by the charcoal, the total pore volume is less than even the volume of the least compressible liquid which enters the pores, when the latter is measured before the penetration occurs, as was done in the experiments. Thus the total pore volume for E 602 is less than 0.534 cc. per cc., and in the case of No. 1 it is less than 0.533. Since the macropores have diameters of the order of 1.2×10^{-3} cm., it is evident that in them the liquids are not materially compressed, so practically the whole of the compression occurs in the micropores.

Experiments upon the adsorption of benzene show that these charcoals adsorb about 0.39 cc. of liquid benzene, 0.35 cc. of water, 0.41 cc. of ether, etc., as measured before adsorption. From this result, together with the data on the adsorption of liquids, it may be calculated that the volume relations for these charcoals are approximately 0.54, 0.28 and 0.18 for the volume of carbon (volume not occupied by liquid), volume of micropores, and volume of macropores, respectively.

These values give a density of 1.60 for the active charcoal. It may be noted that the two specimens of wood charcoal which showed almost no compressive action on the liquids, those from beech and cedar wood, had densities equal to 1.65 and 1.50 respectively, or not far from the estimated value for the carbon in the coconut-shell charcoal.

While Table I. does not give any values for liquids whose percentage compressions have been determined directly at 12,000 atmospheres as lying between that of propyl alcohol and that of carbon disulfide, the determinations on the compressibility of liquids at lower pressures indicate that chloroform, benzene and *p*-xylene are in the proper order. Mr. Monroe's paper will remedy the apparent deficiency, since he has determined the pore volumes for 5 liquids which lie in this range ; amyl alcohol, *iso*-butyl alcohol, ethyl iodide, and ethyl and methyl alcohols. His results give extremely strong additional evidence in favour of the compression hypothesis here presented.

7. THE SMALL EFFECTS OF THE SIZE OF THE MOLECULES, AND OF UNEQUAL ADHESIONAL ATTRACTIONS.

Calculations made on the relation between the lowering of the vapour pressure produced by charcoal and the size of the micro-

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15 Anderson, *Z. physik. Chem.*, 88, 191 (1914).

pores indicate such small dimensions for the latter as to suggest that the size of the molecules might be an important factor in determining the amount of liquid which will enter them. This idea occurred to the writers early in the work, and was suggested to them repeatedly by others. However, although a number of liquids were chosen with the purpose of varying the molecular size considerably, this effect is not so large that it has been possible to detect it as yet. In this connection a determination of the pore volume was made with mesitylene, a liquid whose molecules are very large. For the liquids used the values of b of the van der Waals' equation varied from 14×10^{-4} for water to 88×10^{-4} for mesitylene, which indicates a considerable variation in molecular size. Also it would seem that the force of compression might vary with the nature of the adsorbed liquid, which would indicate that the percentage compressions considered should not be taken at a fixed pressure as was done in Table I. It is evident from the data published here, and even more so from other data to be published later, that these two effects considered in this paragraph are so small as to be obscured by the compression itself.

SUMMARY.

1. This paper gives evidence in favour of the hypothesis proposed earlier by the writers, which is that *the liquids which penetrate into charcoal are compressed by the action of a force, due to molecular attraction, which acts as a pressure of many thousand atmospheres.* In the earlier paper it was estimated that the pressure corresponded to twenty thousand atmospheres or more. The present paper indicates that it is the liquid in the micropores and not in the macropores which is compressed. On this basis the pressure would probably be considerably higher than the previous estimate, since at that time only the total pore volume was known and considered. Not only charcoal, but also all other porous substances, such as porous ceramic materials, and also very fine powders, should exert this compressive effect, bnt in general to a much smaller extent. The remarkable feature of the experiments listed is that they demonstrate the compression by direct measurements of the volume changes in the liquids. Experiments on the internal pressure of liquids have not succeeded in demonstrating pressures higher than 72 atmospheres.

2. Ether, which is much more compressible than water, occupies a volume *in the charcoal* which is about 10% less than that occupied by the amount of water which is, *outside the charcoal,* equal in volume to the ether. It seems probable that the water in the micropores is compressed by about 25%, or even more, while the ether is compressed by about 40%. It is evident that the liquids in the macropores, of the order of 1.2×10^{-5} cm. in diameter, are not compressed sufficiently to produce any noticeable effect upon the volume.

3. The true volume relations in 1 cc. of a characteristic coconut-shell charcoal may be estimated as: volume of micropores, 0.28 cc.; of macropores, 0.18 cc.; of carbon, 0.54; which gives a density of about 1.60 for the carbon. The density of the lumps of such a charcoal is about 0.868, though this lump or "block" density is as high as 1.49 for a charcoal made from anthracite coal, and as low as 0.52 for a wood charcoal.

4. The charcoals which are inactive as adsorbents of gases do not exert a compressive effect upon the adsorbed liquids of a sufficiently great magnitude to be very evident, though there seems to be a slight effect of this natnre.

5. The densities of the carbon in the two inactive wood charcoals investigated are 1.65 and 1.50, which is not very far from the estimated density for the carbon of the active charcoals. It is evident that charcoals from which the hydrocarbons have been imperfectly eliminated may have much lower densities still.

6. When coconut-shell charcoals alone are considered, it is found that in agreement with the data obtained by Chaney and Apmann, the lower the apparent density in an organic liquid, the less is the adsorptive action on vapours. The present investigation indicates that this relation may be expected to hold the better the more compressible the liquid which is absorbed, so either ether or pentane or another highly compressible liquid should be used in such tests.

7. Simple thermodynamic equations are given for the heat of immersion or adsorption of a plane surface. While there is probably no definite area of surface inside a lump of charcoal, a definition for an "apparent area" may be given. The one chosen here is that the "apparent area with respect to the heat of immersion" is the area of the plane surface of carbon which

will develop the same amount of heat on immersion as is equal to that developed by the immersion of 1 g. (or 1 cc., if such a different unit is preferred) of the charcoal in the same liquid. Since the "film" *in the charcoal* is probably a number of molecules deep, this apparent area is probably larger than corresponds to the carbon surface. Nevertheless, this method of consideration gives rise to a lower estimate of the area than the others which have been given in the literature. Thus it is indicated that the apparent area defined in this way is less than 120 sq. meters per gram of charcoal.

8. The magnitude of the heat of immersion of liquids on mercury is 3.13×10^{-6} calories for octane and 3.25×10^{-6} calories per sq. cm. for *iso*-butyl alcohol.

The next two papers of this series will present additional data similar to those given here, and also on the amounts of different vapours adsorbed by the charcoals used in this investigation. These data will make it possible to calculate in much more detail the pressure and cohesional relations involved.

The writers wish to thank Mr. Chaney for preparing several special charcoals for use in this work, and to express their indebtedness to the Wolcott Gibbs Fund of the National Academy of Sciences for a grant which was used in the purchase of vacuum apparatus. While the grant was made for researches upon the cobalt ammines, the apparatus was diverted from this latter work during the war period.

The compressibility data used in this paper are those of Bridgman.[16] Without the results of his remarkable investigations at high pressures, the evidence in favour of the compression hypothesis developed by the writers would have been much less convincing.

Note added Oct. 26, 1921.

Washburn[17] has devised a method for determining the "true" volume of the pores in a ceramic material by the use of a gas, such as hydrogen or helium, as the liquid for filling the pores. This method has been tried in this laboratory, and has been found to be much less simple when applied to charcoal, but it will undoubtedly give consistent results when sufficient care is taken. The data obtained thus far will not be published until they are more carefully verified. With accurate data of this nature it may be possible to calculate more exactly the pore volume and the density of charcoal, though, on account of the small size of the molecules of helium the volume of the pores penetrated by this gas may be greater than that penetrated by the larger molecules of an organic liquid. Also it seems apparent that even at ordinary temperatures the density of the helium gas is not the same in the micropores as in the free gas, that is, there is a small amount of adsorption.

Chicago, Ill.

16 Bridgman, *Proc. Am. Acad. Arts Sci.*, 49, 3-114 (1913); 48, 309-362 (1912).

17 Private communication from Professor E. W. Washburn. Note added October 26, 1921.

SUBSTANCES DISSOLVED IN RAIN AND SNOW.

By Sherman Shaffer.

The determination of the character and quantities of the substances dissolved in rain and snow is of considerable interest and importance. My work is a continuation of the rain and snow analyses which have been made at Cornell College for a number of years

The samples for analysis were collected in enamelled ware pans, at an open spot near the centre of the village of Mount Vernon, Iowa. Mount Vernon is a town of about 2,100 population, situated seventeen miles from a manufacturing centre, and with no industries of its own. The samples were analysed as soon as possible after they were collected. They were analysed under ordinary laboratory conditions, but every precaution was taken to ensure that no contamination should take place.

Forty-five samples of rain and snow were analysed during the period from August 18th, 1920, to June 1st, 1921. The precipitation during this period was 20.97 inches, 18.14 inches of rain and 34 inches of snow. Twelve inches of snow are taken as equal to one inch of rain.

The nitrates which fell during this period amounted to 0.60126 pounds per acre, assuming that one inch of rain on an acre weighs 226.875 pounds. The average content was 0.3 parts per million. The highest nitrate content was 1.0 part per million on January 4th, 1921. The amount of nitrates is influenced by the length of the interval between rains. A curve drawn between intervals between rains as abscissa and nitrates per inch of rain as ordinates tends to rise as the interval is increased. There is no noticeable variation of the amount of nitrates with the seasons. On the contrary, the average through the year is quite constant. When the amount of nitrates per inch of rain for each month is compared with the rainfall in inches for each month, it is found that the nitrates per inch are greater

when the rainfall is less; that is, the solution is more concentrated, as might be expected. When the nitrates are determined by the phenolsulphonic method and no sodium carbonate is added before evaporation of the water, very little nitrates is found. This would seem to indicate that all the nitrate is in the form of free nitric acid. If this is true, the ammonia present must be united with some other acid radicle or it would unite with the nitric.

The nitrites totalled 0.03985 pounds per acre. The highest figure was 0.03 parts per million on April 17th, 1921. The average was 0.0033 parts per million. A curve between time interval between rains and nitrites per inch of rain showed an increase with an increasing interval, but the curve was very irregular. The nitrites, like the nitrates, tended to greater concentration when there was less rain, but the tendency was not so marked as in the case of the nitrates.

The total amount of free ammonia was 1.48045 pounds per acre. The highest ammonia was in the snow of November 27th, 1920, which tested 2.1 parts per million. The average was 0.b7 parts per million.

On the whole, no difference was found in the amounts of substances dissolved by snow and rain under the same circumstances. This differs from the results of former investigators, who found that snow did not ordinarily carry down as much of the substances found as did rain.

The albuminoid ammonia amounted during the period to 1.16022 pounds per acre. The highest was 2.0 parts per million, on December 13th, 1920. The average was 0.38 parts per million, considerably less than the free ammonia. A curve drawn between albuminoid ammonia per inch of rain and time interval between rains shows a very striking increase of ammonia with increase of time interval. The albuminoid ammonia remained on the average fairly constant throughout the year, as did the free ammonia. Both were lower in the spring than during the fall and winter.

A total of 34.43179 pounds of chlorides per acre were found. The average chlorine content was 10.1 parts per million. The highest was 49.7 parts per million. The chlorides were higher during the winter and spring than during the fall. They were not found to be present in constant proportion as was found by former investigators, but varied from 3.5 parts per million to 49.7. The chlorides show the same tendency as trated when the rainfall is less. A curve drawn between chlorides and intervals of time between rains shows an increase in chlorides with the increase in time interval.

Former investigators have attributed the presence of chlorides in rain and snow to the salt spray of the ocean, whipped up and borne away by the winds. We questioned this source, in view of our great distance inland, and undertook a series of analyses of the chlorides found in rain water. The method employed was to evaporate five to ten litres of rain water, carefully excluding all laboratory dust, and determine the proportion of sodium and potassium present by the chloroplatinate method. The analyses gave such varying results that we conclude that the source of the chlorides is not the ocean spray, at least, not to any great degree. Such a source, according to the published analyses of sea water, would supply a large preponderance of sodium over potassium salts, while the reverse was found to be the case in some cases. This would imply that the true source of these chlorides is to be found in the fumes from industrial plants, the greater quantities of potassium being explained by the more volatile nature of its salts. Another source which has been suggested is the dust from the Western deserts of the United States, which is known to be carried great distances by the wind, and which would doubtless be alkiline in nature.

The total sulphates amounted to 102.08035 pounds per acre, figured as SO3. The average was 29.9 parts per million, and the highest 101.2 on May 17th, 1921. The very large amount of sulphates found is probably due to the cheap grade of coal which the high prices forced consumers to use. The sulphates found rise from none in August to 66.2 pounds per acre in February, after which they again decline.

Thirteen determinations of sulphurous acid were made, using N/10 iodine-potassium iodide solution against N/10 sodium thiosulphate solution. Seven of the tests showed none present. The average of the other tests was 1.43 parts per million. The highest was 1.8 parts per million on May 17th, 1921.

The total nitrogen which fell in all forms was 3.28178 pounds per acre. This was divided as follows: as nitric acid, 5.74 per cent.; as nitrous acid, 0.51 per cent.; as ammonia, 93.73 per cent.

Grateful acknowledgment is made of the kind assistance and suggestions of Dr. N.

MINISTRY OF AGRICULTURE AND FISHERIES.

(*Ministry of Agriculture and Fisheries Leaflet No.* 383.)

HINTS ON GOAT-KEEPING.

Smallholders, agricultural labourers, allotment holders, cottagers and others who have surplus vegetable material from gardens or allotments, or who have access to cheap grazing or to supplies of wild green food, will find it useful and economical to keep a milking goat, especially if any difficulty is experienced in obtaining regular supplies of fresh cow's milk.

The initial cost of a goat is small, and the necessary housing is inexpensive. Any small shed will serve so long as it is clean, dry, light and properly ventilated.

A milking goat of ordinarily good quality should yield, under proper management, from 70 to 100 gallons of rich milk in a year. A first-class animal will give double this quantity, and will probably cost no more to keep than a poor milker.

When buying a goat the purchaser should satisfy himself as to its milk yield, preferably by seeing it milked. A goat which gives less than two quarts a day within a few weeks after its second kidding is hardly worth keeping.

It is *not* essential that goats should be turned out to graze. A milking goat may be fed in its shed all the year round, provided it be given sufficient exercise and be supplied with the necessary variety of food.

A milking goat costs very little to keep. It will thrive on vegetable waste from the garden or allotment, and on hedge trimmings, acorns, and such weeds as dandelions, sow thistles, docks, young nettles, etc., with the addition of a little bran, oats or cattle cake. A small allowance of hay is required in winter. Yew and rhododendron leaves are poisonous to goats.

Goats will eat almost anything, but will do damage to fruit trees and hedges if not kept under proper control. They should never be let loose in gardens.

Goat's milk is rich in fat and albuminoids, and is usually remarkably free from tubercle bacilli. It is very digestible and is particularly suitable for invalids and children.

There is much misunderstanding as to the flavour of goat's milk. If a goat is kept properly and given suitable food, as described above, its milk is equally as palatable as cow's milk.

Further information on the subject of goat-keeping is given in Leaflet No. 306 (*The Goat as a Source of Milk*), single copies of which may be obtained free of charge and post free on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

NOTE ON THE MODIFICATION OF DUANE'S APPARATUS FOR PURIFICATION OF RADIUM EMANATION.

In 1915, Professor Duane[1] published a method for the purification of radium as collected from aqueous solution, without the use of liquid air. Collection was effected by mercury displacement by means of a system of glass bulbs which acted as an internal pump. In order to remove oxygen and hydrogen from the gaseous mixture, the gases were passed over an electrically heated, partially oxidised copper wire. The glowing wire causes the hydrogen and oxygen to unite, and the excess of hydrogen is reduced by the copper oxide. The water-vapour formed is removed by a side tube containing P_2O_5. The disadvantage in using an oxidised copper wire as the heating body is twofold. On account of the low resistance of copper, a rather high current, 10 to 15 amperes, must be used initially. As the gas pressure diminishes, the current must be correspondingly diminished in order to avoid overheating of the copper wire.

The modification in the furnace consisted in utilising a platinum wire instead of copper. This has a double advantage in the high melting-point of platinum, and its high resistance. About 5 feet of No. 32 wire was wound on a small rod of silica 5mm. in diameter and 15cm. long. This was then incased in a thin tube of transparent silica fitting snugly over the spiral coil. It was found that sufficient heat was conducted through the quartz tube to raise an oxidised copper ribbon, wrapped spirally outside of the quartz tube, to a sufficient temperature to cause hydrogen to be reduced. By this indirect heating of oxidised copper the temperature was controlled so that there was no danger of overheating the copper, and a very low current, 1 to 3 amperes, was sufficient. Such a furnace was satisfactory for a period of nearly a year without renewal. The copper had to be re-oxidised from time to time, as in the original Duane apparatus.

GENERAL NOTES.

We have received from the Editor of Publications, Department of Industries, Government of India, the Journal of Indian Industries and Labour for November, 1921. It is a well-printed journal of some 150 pages, containing a number of interesting original articles. Amongst others we notice articles on Smoke Prevention and Fuel Economy, Modern Paper-making, Handloom Weaving, Mangrove Swamps, Industrial Disputes, together with summaries of industrial intelligence from Assam, Bengal, Madras, and other provinces.

The journal is published by order of the Government of India, and can be obtained from any prominent publisher in Europe.

DEMAND FOR REDUCTION OF COMMERCIAL MOTOR TAXATION.

The National Council of the Commercial Motor Users Association, Incorporated, will at its next meeting, to be held in London on the 1st February next, consider a motion from its London and Home Counties Division in favour of the necessary steps being taken to endeavour to secure at least a one-fourth all round reduction of motor taxation in the next Finance Act.

The Editor of the *Blackpool Times* has sent us a copy of their issue for 6th January, 1922, containing a number of illustrations produced by the photo-litho offset process, and it is claimed that this is the first newspaper in Great Britain and Ireland containing illustrations produced by this method.

The pictorial effect is very good. A view of Bispham Parish Church with its surroundings is a very creditable production, but other photographs, particularly the full page of the local parliament, leave very much to be desired; the faces of the gentlemen present are very lacking in detail, and the general effect of the chamber is rather startling. In all probability, however, the pictures will be improved upon in future issues.

We have received a proof of an important paper read on the 12th inst. before the Optical Society, on the manufacture of Optical glass, by C. J. Peddle, M.B.E., D.Sc., F.I.C., F.Inst.P.

The paper deals exhaustively with the manufacture of optical glass, from the early work of Faraday, Herschel, Dollond and others, down to the present day.

The importance of this manufacture was brought home to all of us during the great war, and it would be a calamity if the knowledge gained under that impetus was not followed up. Dr. Peddle's paper is very fully illustrated, contains a mass of experimental detail carefully described, and is a valuable contribution to our knowledge of the subject.

MINISTRY OF AGRICULTURE AND FISHERIES.

INSECTICIDES AND FUNGICIDES.

A Bill has been drafted for the regulation of the trade in certain of the chemicals most generally used for the control of pests. Certain of the more important provisions have been published in the form of a pamphlet for the use of the public and for manufacturers, and specifications are given for the following substances:—Lead arsenate paste, lime-sulphur, nicotine, copper sulphate, soft soaps, sodium and potassium cyanides, formaldehyde, and liver of sulphur.

Copies of the leaflet No. 563 may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

THE ROYAL SOCIETY OF ARTS.

LECTURES ON "THE MIND."

A series of eight lectures, arranged by the People's League of Health, 12, Stratford Place, W.1, is to be delivered at the Royal Society of Arts, John Street, Adelphi, on Mondays in February and March, at 6 p.m., on "The Mind and what we ought to know about it." The subjects and lecturers are as follows:—"Primitive Instinct" (Dr. Bernard Hart), Feb. 6; "Sensation, Perception, Ideation, and Attention" (Dr. R. H. Cole), Feb. 13; "Association of Ideas, Recognition, and Memory" (Dr. R. S. Rows), Feb. 20; "Habit Adaptation" (Sir Maurice Craig, M.D.), Feb. 27; "Fatigue and Sleep" (Sir R. Armstrong Jones, M.D.), March 6; "Mind and Body" (Sir F. Mott, M.D.), March 13; "Crime and Delinquency" (Dr. W. A. Potts), March 20; "Mental Deficiency" (Dr. Tredgold), March 27.

Professor J. A. Fleming, Professor of Electrical Engineering in the University of London, delivered the last of a series of

Christmas lectures on electric waves and wireless telephony at the Royal Institution yesterday afternoon. The lecture was illustrated by numerous diagrams and lantern slides, as well as by many fascinating experiments, the uniform success of which was no doubt the reward of long and careful preliminary preparation.

The feature of the afternoon was the transmission by wireless telephone from Marconi House in the Strand of several musical items, which were reproduced with remarkable clearness and made audible to everyone present, by means of a stentorphone in the lecture hall. The first was a gramophone record of "Rule, Britannia," played by a band, the second a song, and the third a violin solo by Kreisler. In addition, the Duke of Northumberland transmitted the following message to the audience:—"As President of the Royal Institution I take this opportunity of sending my heartiest greetings for the New Year to the audience which is now gathered to listen to Professor Fleming.

OBITUARY.

EDWIN JOHN DAVEY.

With very great regret we have to announce the death in his 78th year of Mr. Edwin John Davey, who for nearly forty-five years was responsible for the printing and publication of the *Chemical News*. Mr. Davey practically devoted the whole of his time to the work of the paper, and during the life of the late Sir William Crookes was mainly responsible for all the details of publication. He felt the death of his old chief keenly, and for some time past has been failing in health.

ROYAL SOCIETY.

List of probable papers for reading on January 26:—

W. B. Hardy, Sec.R.S., and Ida Doubleday—Boundary Lubrication—The Paraffin Series.

Prof. W. A. Bone, F.R.S., A. R. Pearson, E. Sinkinson, B.Sc., and W. E. Stockings—Researches on the Chemistry of Coal. Part II. The Resinic Constituents and Coking Propensities of Coals.

J. A. Crowther, D.Sc., and B. J. Schonland, B.Sc.—On the scattering of B rays. Communicated by Sir Ernest Rutherford, F.R.S.

Ann C. Davies—The Minimum Electron Energies associated with the Excitation of the Spectra of Helium. Communicated by Sir Ernest Rutherford, F.R.S.

C. N. Hinshelwood, H. Hartley, and B. Topley. The Influence of Temperature on two Alternative Modes of Decomposition of Formic Acid. Communicated by Professor J. W. Nicholson, F.R.S.

C. V. Raman, D.Sc. On the Molecular Scattering of Light in Water and the Colour of the Sea. Communicated by Dr. G. T. Walker, F.R.S.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ANNUAL GENERAL MEETING.

The annual general meeting of the society will be held on Wednesday, February 1st, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The accounts for the year will be presented, the President will deliver his annual address, and the election of officers and Council for the ensuing term will take place. The appointment of Auditor will also take place.

The ordinary monthly meeting of the society will be held immediately following the annual general meeting, when the following papers will be read:—

"Studies in the Titration of Acids and Bases." By J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

"The Sulphuric Acid Reaction for Liver Oils and its Significance." By J. C. Drummond, D.Sc., F.I.C., and A. F. Watson, B.Sc., A.I.C.

"The Quantitative Separation of Nitrobody Mixtures from Nitro-glycerine." By William Dickson, F.I.C., and W. C. Easterbrook.

INSTITUTE OF CHEMISTRY.

The London and South-Eastern Counties Section of the Institute of Chemistry will hold an Exhibition of Apparatus other than glassware in the Laboratories of the Institute on Wednesday, January 25th, from 6 p.m. to 10 p.m.

GERMAN REPARATIONS IN KIND AS AFFECTING BRITISH ENGINEERING INDUSTRY.

It is stated in the Press that important Ministerial conversations are taking place

in regard to the German reparations and the feasibility of our accepting part payment thereof in kind.

Furthermore, suggestions have been made *in the Press and elsewhere that such part* payment in kind might take the form of the supply by Germany of the machinery, plant and other equipment for a number of large electric generating stations—so called super power stations—and for electrification of railways in Great Britain.

The British Engineers' Association takes the strongest possible exception to the above mentioned suggestions. The objections to this procedure are fully stated in a letter which has been addressed to the Prime Minister by the Director of the Association, Mr. D. A. Bremner.

A copy of the letter has also been forwarded to the Federation of British Industries.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks and Designs can be obtained gratuitously.

Latest Patent Applications.

35062—Bloxam, A. G.—Colloidal-chemical processes for purifying substances. Dec. 30.

34955—Cassella & Co., L.—Vat dye-stuffs. Dec. 29.

34991—Cook, D.—Chemical and/or physical synthesis. Dec. 30.

35064—Gerb und Farbstoffwerke, H.—Manufacture of salts of sulphonated coumarone resins. Dec. 30.

34970—Nobels Explosives Co., Ltd.—Manufacture of hydrazine. Dec. 29.

34838—Saltrick, W. R.—*Purification of ferro-alloys* of refractory metals. Dec. 28.

Specifications Published this Week.

146,139—*Bucherer, Dr. H.—Process for the pro*duction of derivatives of condensation products of formaldehyde and phenols.

172,688—Schroeter, G.—Hydrogenation of napthalene.

161,553—Lipman, G. J.—Culture of sulfur-oxidizing bacteria and their application.

172,858—Hargreaves, L.—Manufacture of sodium thiosulphate.

Abstracts Published this Week.

Antiseptics. Patent No. 171,418. Some new methods of preparing antiseptics, *particularly* chloro-phenols, have been invented by Mr. W. H. H. Norris, of 20, Church Lane, Prestwick, Lancashire.

The componnds are prepared by chlorinating the sharp oil produced by removing phenol, cresols, and xylenols from coal tar or blast-furnace tar cresote oil; the sharp oil contains phenolic bodies of high boilng pont. The chlorination may be effected by means of chlorine, or a compound thereof, such as sodium hypochlorite or sulphuryl chloride; preferably the sharp oil is dissolved in a solvent such as carbon tetrachloride. From 80 to 140 per cent. by weight of chlorine is introduced in stages at progressively increased temperatures. The products may be rendered soluble or miscible with water by means of alkali; alone or with addition of emulsifying-agents, such as mapthenates, soaps, resin soaps, sulphonated fatty oils or acids, casein, gelatine.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on *post free for the official price of 1s. each.*

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3224.

SIGNS OF A TRADE REVIVAL.

FOREIGN MISSION OF A WELL-KNOWN MANAGING DIRECTOR.

Note from the Manager, Publicity Department, Industrial League and Council.
January 17th, 1922.

Numerous references have been made of late to incidents which point to the fact that a revival in trade is gradually assuming definite shape, and although to the average individual nothing tangible is visible, it is evident that there are grounds for the optimism that has led to public utterances on the subject by many prominent men. While big financiers are regarded as the men who know, since it is their business to be able to interpret the meaning of the vascillations of the market, it is proverbial that the great manufacturers, who, metaphorically speaking, have to understand the pulse of industry, are in a more favoured position in regard to foreseeing the trend of events, and it is significant that of late many have taken steps to put their house in order as though to welcome a belated guest.

In many cases the managing directors of firms have, notwithstanding the activities of their representative men, stepped once again into the arena of foreign agency in order to give added impetus to the immediate prospects of industrial revival, and a notable instance during the week end was the departure of Mr. E. W. Petter, Chairman of the British Engineers Association and a member of the Executive Committee of the Industrial League and Council, for India.

Mr. Petter is sailing to Bombay by the Macedonia, which left London on Friday, but he personally left town on Saturday, travelling overland to Marseilles, where he joined the boat on Monday, the 16th inst. He intends to make a complete tour of the important Indian centres, taking in Bombay, Madras, Calcutta, Delhi, Lahore, etc.; and anticipates returning early in May.

Regardless of the much vaunted aggression of German industrialism contingent upon the depreciation of the Mark and the appreciated position in the world's markets, from a competitive standpoint, of her manufacturers, the tentacles of the industries of Great Britain are slowly but surely gaining a hold in all the vital markets of the world, and just as soon as the orders now being negotiated reach our workshops and factories, so will the wheels of industry commence to revolve in this country.

RELATIONSHIP BETWEEN CALCIUM AND STRONTIUM.

To the Editor of the *Chemical News.*

Dear Sir,—Several months ago, you published a note called "An Extraordinary Relationship between Calcium and Strontium." Subsequent inquiry showed that the title was justified, because the relationship at this position of minimum deviation is a theoretical one. Not only so, but also there are reasons for believing that there is no number other than 2878, which is itself a four. The reasons are the following:—

1. There is a real relationship between the elements of group IIA and those of group VIII, which has been discovered by the author:—

$$1 - \text{Sr.} = 2 \times \text{Fe} \times \log_{10} 1{,}290.$$

So that calcium on the one system, and iron on the other, which are represented by approximately the same number, are also both related through strontium, in a fundamental way. This by itself would justify the use of *the four figure number, without* the addendium. Similar arguments would treat of other fifth place ciphers.

2. The logarithm of the reciprocal of the Barium product (Bd = 98631.) — 02 is cobalt − 018.$_4$ $\log_{10}$ 1878 being 27184 + 00184.

This connection being further justified by the fact that the product corresponding to the log. − 02 contains the same ciphers as the Ba. number itself = 26831. The corresponding log. and reciprocal being 1/7 and the atomic weight of mercury on a very important system of units (which will be established later) 863 = 8Ag.

3. 1878 with addenda can exist as an integral portion of a number with the addendum determining the precise nature of the association. For example: 18786 × 2

= 37572. log. 27572 = 44046. 27572 = 2 × 13786 = log. of 13736 = Ba. If now log. 13786 = 13944 is made fluorine (3944 = 2 Au.), in the relation 1/F = log. *x* I. 1365 = *x*. i.e., = F. Cl = 2546, and the difference between the value of *x* and the anti-logarithm = *x*; while 1352 = *x* $\log._{10}$ of 1365 when I = Te, and the anomaly of the periodic system removed. Since 1972 = Au. it would not be unreasonable to assign the value 27571 to Ag., F. remaining 13736. The correct equivalent of F. is 48563, and log. = 68631. 8631 = 8 Ag. The sum of the values is 62298, the number following the six is probably 22933, which is a very important numerical association. The difference is 34829. The number without the first cypher is the atomic weight of Cl. on a system of units obtained by interchanging silver and selenium with respect to the multiplicand 1106. Ag. × log. [129] = Sn. +. And on the same system log. Sn. = Cl., and sulphur and chlorine are also number and logarithm to the Napierian Base. The sum of the values of Ag. is 10555. The property of Ag.1/F. is, as it is well known, anomalous, as also that of Ca F. with respect to its solubility in water. It is near the position of minimum deviation that this happens.

4. As a further illustration of this type of relation, take Se = 7642 = 35284 ÷ 2 −1. Fe = 10784 ÷ 2, log. Au = 5588 ÷ 2. But when Ca = 4013, leading to 2 × 15326 Au. = 1326 and Fe = 2 × 1878. Na = 4 × 3617. It is possible that all these numerical associations are operated upon by some new function of numbers, and that four plays an important part. For example, 4829, which is called a four function, has the following associations:— 34829 → 13829 √13829 = 37187. √3829 = 61879. 34829^2 = 2 × 6065. Log. 4041 = 6065. 4041 = 6357^2. √174145 = 4173 = 4144 + 0029. 3546 — 6357 = 7189. 4404 − 405 = 0354 → 10849 → 12159. 4404/12159 = 3622. 64385 − 0849 = 55895 (Fe. Co.); sum = 72875 → 53548. There seems to be a tendency from strict mathematical relationship, which realises itself through other subsidiary relationships between substances. The best method to adopt under the circumstances is to arrange the atomic numbers as "coefficients" of 1878, and to suit any particular association Ca = 28755. Sr. = $\log._{10}$ 4009. Product by adjusting the fifth place. For example, = 35302. Log. 3503 = 54444. 3503/2503 × 23026 = 32222.

The following are several coefficients:— Co. 22545 $\log._{10}$ = 35306. Mn. = 21 log. = 32223. Ca. = 15327. log. = 18546. Na. = 87933. C. = 45584 log. = 66166. Si. = 1082; log. = 03422 (27377).

Aluminium and gold coefficients:—Cl. = 2546. Au = 75393. log Al = 015393. This is the position of minimum deviation, and is in parallel with Zn. = 65394 27183. Aluminium, gold and zinc are not in the same group. The aluminium—gold-relation persists for a certain range of values, and in other regions the deviations are comparable to the values themselves.

Au. = 21000 Al. = 28868 log. coef. Al. = 04283. coef. Au. = 80286.

Au. = 3911 Al. = 53763 log. Al. = 3129. Coef. = 2055 Au. = 14952 d. = 2052.

Au. = 792 Al. = 1089 log. Al. = 03692. Coef. Au. = 3027. Au. = 41623 d. = 404.

5. With the aid of these coefficients the relationship between Gp. II.A and Gp. VIII. is extended to nickel, manganese, and magnesium. This must be preceded by the establishment of another system of units, which is done very simply. Let Ca. approximately 1145. 2145 × 4 = 858. log. *x* 758^2 = 1145. $\log._{10}$ *x* = 858. Let Br., 858

which is approximately twice Ca., be 2283. Then the value of Ca. becomes exactly the one to render the square relation, accurate to the fifth place. Pb. = 5916. Mn. = 15691. Ag. = 30816.

The manganese coef. is 21. Nickel 22434. Let Cl. = 22432. Zn. = 41353. Calculating S. on Mg. 22432 gives 2958 = Pb./ 2 Log. 22432 = 5691. *x* = 41353 = Zn.; for a short range of values the differences between the radices obtained in this way from 41353, and those of Pb. from 5916 are proportional. The position of minimum deviation is thus related to the whole number 21 Mn., which would control deviations. If the same operation is performed on 22434, then Zn. and the radex differ, *r* = 41339, Zn. = 41357; but $\log._{10}$ *x* = 61632 = 2 Ag. And 61632 is a fragment of a serial 2433^x = 2433 . ∴ . *x* = 53286. Ca. coef. = 15327. $\log._{10}$ 3887 = 5896. $\log._{129}$ 3887 = 5329. The serial 243589 is completed with 616362

if Mg. is equated to consecutive portions of the serial, so that two portions have one or more ciphers in common (and correcting for chemical equivalent, *e.g.*, Mg. = 2436, Mo. = 9615). The serial as a fraction = 2 × 7083. 2 Mn. = 31386 is also a fragment of the complete log. 129.11063138666. Again, 2434, corresponding to 1878, is an important value. When Na. and 15322, which is the characteristic number of *e*. (and which has been derived by the writer entirely from base 10), are made equal in face value, Na. = 298, 15322 = 1985, iron and sodium, which were before only approximately related, now become exactly related. $Log._{10}$ 62 = 5587. Fe. = 7236 = 3618 × 2. In similar manner let Mg. and 15322 be equalised, then Mg. = 28571 (1/7) Ni. = 8937. log. *x* 2432 = 34469. *x* = 12941. $Log._{10}$ 25882 = 41300 = 2 + 4 × 5325. Reciprocal 2*x* = $log._{10}$ of 2434. 2 × recip. Ni. = 1290124, which is the value of this most important base, derived also from the cube-root of the ratio 8338 and 3883.

6. Referring now to 22983 = 15322 × 3/2 log. *x* 2283 = 9. *x* = 32314. Log. (298 × 4 — 1) 192 = 198; *x* = 5 – 32314. It is with the aid of this type of numerical relationship that the relationship between calcium and strontium was extended over a very wide region where squares and logarithms are corelated. Interpolating 9 in 8733 gives the Na. coef. 87933. Log. *x* 8733 = 9. *x* = 5 – 35646, and log. (793 × 4 – 1) ²/3172 = 693. *x* = 17729. 06907 – 84073 – 22833. $Log._{01}$ 693 = 84073. 8407 × 356 = 8763. $Log._{10}$ 84074 = 92466. 9109 = 45749. If values of Ca. are calculated on Sr. 8407, for given values of Sr. the relation between the Ca. and Sr. products with respect to squares and logarithms extends between the limits Sr. = 35646 and 65581 = 8763/8407 × 62918, with the aid of the constant 2663 = 65581 – 62918 (5326/$_2$) and whole number multiples thereof, and between 617 and 64 without a constant (numbers in agreement below this limit can be shown to be on a bottom). Half the difference between the Ca. product and the square is equal to the Sr. product—the logarithm. This is also the case at the position of minimum deviation, when 101 is used. The limits can be fixed arbitrarily to correspond with those of the method for *e*., for the relation 655/555 23043 (log. 10 27162 4th fraction) between the limits 27083 and 27195. The difference between the strontium product and the logarithm is the same for 35646 as for 6525; product = 27193; and is appr. 526 = 1/19. With the aid of this number the 129 base is determined. $Log._{10}$ 19 – 4 × log. 129 = 72126 = log. ¹/19. Product at 6558 is 27168. For the exact difference of 52493 $log._{10}$ Ca. = 230387, there is obtained 1108525 and 129078 and 44025.

The absolute limits are Ca. = 25025. Sr. = 61362. The relation of the Ca. product with $log._{10}$ Sr. commencing at 4th decimal place, and values of Sr. are referred to the Ag. fragment. The limits are made to correspond exactly to those of the method for *e*, by interchanging 1 and 0 at the two limits (see Example 5).

Examples:—

1. Sr. = 64. Sr. pr. = 2729. Ca. pr. 34249 $d_1/2$ = 03925; d_2 = 03923.
2. Sr. = 617. Sr. pr. = 2748. Ca. pr. = 34882. $d_1/2$ = 14145. d_2 = 1349. d_3 = 000655.
3. Sr. = 616362 Sr. pr. = 27485. Ca. pr. = 34900. d_1 = 2701, d_2 = Telurium = 1275. The serial 61636 is given elsewhere.
4. Sr. = 392. Sr. prod. = 30911. Ca. pr. = 29313. d_1 = 16348. d_2 = 74532. Subtracting 5326 gives 2127 = 10635 × 2.
5. (*a*) Ca. = 25025. log. Ca./Ca. = 22157. log. 23026 = 3622157. d_1 = 88352 – 22575 = 15772; d_2 = 15721. 616362 – 52481 = 45775.

   (*b*) Ca. = 2926. d_1 = 1103. d_2 = 2113. The Ca. sq. = 37095. Ca. pr. × 2 = 6996. $Log._{10}$ Sr. = 7878995 and for other values by multiplying the Ca. product by a whole number, *e.g.*, 34953 × 6 = 209718. $Log._{10}$ Sr. = 7885718 d_1 = 7683. Sr. = The fragment – $log._e$ 6.
6. Subtracting 7782 gives d_1 = 1043. d. = 2 × 10438 at the limit, multiplying by *K* = 23043. and ½ 61362 – 20876 = 805.
7. Log 10 = 23026. S = 3206. The change of zero position which is coincident with certain mathematical

relations, is operated upon, by some general law. Let Sr. = 174 = 2 × 87. Cl. 7041. Ca. = 79606. A second value for Sr. can be obtained thus: 7401 → 8401 − 1599 62534 = Sr. Log. 62534 = 79612 d. from Ca. = 6. Log. $Sr._{n} \times Sr._{2}$ = 44444. Log. 274 = 100796. Similar procedure with Cl. = 506 leads to radex 63096. $\log._{10}$ = 8. Cl. = 3206. Sr. = 16739. Sr. = 4143 Sr./Ca. = 46184 (Fe). Ca. = *36245. 46184 184736. log. 7041* = 84763. 84736^2 = 71803. 625431 **is a fragment which transforms logarithms from the base 10 to *e*** via the Ca/Si relation.

8. The **strontium product at the position of *minimum deviation* added to the preceding value of calcium,** gives 2 Mn. 27377 + 04009 = 31386. = 2 × 15693.

Also 22434 (Ni. coef.) times 256 (*log.* 94) 87633.

For a value of Ca. = 42. Leading to Cl. = 27147.

Sr. = 67087 Ca. = 30692; the sum of Sr. product and Ca. = *31259* 2 Mn. Ag. becomes 30691 = Ca.

I am,

Yours truly,

A. Sakoschansky.

PHOSPHATE DEPOSITS OF NAURU AND OCEAN ISLANDS.

An account of the phosphate deposits and workings of Nauru and Ocean Islands, written by the Australian Commissioner on the Board which controls the phosphate business of the islands, and published by the Government of the Commonwealth of Australia, has been received from H.M. Senior Trade Commissioner in Australia, and may be seen by United Kingdom firms interested on application at the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.—*Board of Trade Journal.*

REACTIONS BETWEEN THE HIGHER FATTY ACIDS AND SALTS OF THE LOWER FATTY ACIDS.

BY

Arthur W. Knapp and Raymond V. Wadsworth.

This investigation resulted from our discovery of the following fact:—

> If finely powdered sodium acetate is added to oils, or melted fats, a jelly or gelatinous precipitate is generally produced.

The dried salt gives more, and the anhydrous salt most jelly. Sodium propionate and sodium butyrate produce similar results. Jellies occupying from one-third to eight-ninths of the volume of the oil were obtained by warming 5 per cent. of the anhydrous sodium acetate with oils consisting mainly of different characteristic glycerides, such as linseed oil, cocoanut "stearine," cacao-butter and olive oil (the oils contained from 0.5 to 2.5 per cent. of acidity reckoned as oleic acid). Castor oil (acidity as oleic acid 1.2 per cent.) gave no jelly. This characteristic action of castor oil has not been further investigated. It would appear either that ricinoleic acid does not decompose the acetate, or if it does, that the soap formed remains in solution.

If the oils are washed with alcohol so as to free them from fatty acids, no jelly is obtained with acetate. That the acetate does not react with the glycerides is also shown by the fact that no acetin is formed. Pure glycerides do not react with sodium acetate, but samples of the following glycerides, which had been prepared six years and hence were slightly decomposed, gave gelatinous precipitates:

tributyrin	trilaurin	trimyristin
tripalmitin	tristearin	triolein

The jellies so obtained are soaps, formed by the intersection of sodium acetate and the free fatty acids. We have here the basis for a new method of removing fatty acids from fats which might prove to have important technical applications.

ACTION OF SALTS WITH FATTY ACIDS.—It is well known with regard to the fatty acids that the greater the molecular weight the weaker the acid. This is

stated to be well shown, for example, by the marked decrease in the heat of neutralisation. But we find that if the higher fatty acids be put in presence of the salts of the lower fatty acids, the weaker drives out the stronger. The first cause of this reaction is that the salts are soluble in the acids, whereas the soaps form only colloidal solutions. On applying heat the reaction proceeds because the stronger acids are the more volatile, and hence in this respect the action is analogous to the action of sulphuric acid on sodium chloride. Thus if sodium acetate is added to liquid stearic acid, the odour of acetic acid is perceived, and if the mixture is heated to 110°C. for some hours so that the acetic acid can escape, the action continues to completion and pure sodium stearate remains. A similar reaction takes place with palmitic, myristic, lauric, and even caproic acid. From the fatty acid and salt a clear solution can be obtained which appears to be a colloidal solution of the soap. This is best observed with oleic acid, which acts in the same way as the saturated acids. Sodium acetate is soluble in oleic acid at 30°C., and is crystallised out from solution at about 22°C. At 40°C. about 10 per cent. can be dissolved. As soon as the sodium acetate is dissolved the oleic acid becomes more viscous. At 100°C. molecular proportions of oleic acid and sodium acetate give a clear solution. On cooling, this becomes a very thick jelly. Contrary to expectation, we find that when either stearic or oleic acid is mixed with an equivalent proportion of sodium acetate, heat is given out.

If the fatty acid, e.g., stearic acid, is dissolved in absolute alcohol and the acetate added, a gelatinous precipitate of soap is formed almost immediately. If water is now added, the reaction is reversed and we obtain the original fatty acid and sodium acetate.

COLLOIDAL SOAPS IN OILS.—If one per cent. of sodium acetate, propionate, butyrate, caproate, myristate, laurate, palmitate, stearate or oleate be added to an ordinary fat or oil (containing as usual free fatty acids) and warmed, a jelly or gelatinous precipitate (which in time settles towards the bottom of the vessel, forming a denser and more visible mass) will he formed in the case of he salts of the *lower* fatty acids. This is due to the reaction we have described above. With the salts of the *higher* fatty acids a certain amount of the salt or soap goes into solution, but precipitates on cooling as a gelatinous mass. This is only clearly shown when a large percentage of fatty acids or olein, in which the soaps are soluble, is present. Sodium formate differs from the other salts, in that it is a salt of a much stronger acid, and its solubility in fatty acids is very low; consequently it does not give a jelly with olive oil, and only very slowly reacts with the higher fatty acids to form soaps.

All the jellies are formed most readily in the complete absence of water. They can be obtained as solutions in olive oil (which is rich in olein) by warming and filtering at 100°C. The soaps, under these conditions, are reversible colloids. On cooling, the jelly is usually slowly deposited as a mass of minute globules.

GENERAL NOTES.

MINERAL RESOURCES OF THE REPUBLIC OF COLOMBIA.

Although the public finances of Colombia are embarrassed, and the chief dependence at present for improvement is the prospective payment of 25 million dollars by the United States on account of the secession of Panama—which includes the Canal Zone—there is great potential wealth in the country. Gold, silver, and platinum are produced, and in the Eastern Cordilleras are large known deposits of iron, coal, copper, lead, quicksilver, and other metals and minerals. The emerald mines, controlled by the Government, are claimed to be among the richest deposits known anywhere. Petroleum has been prospected for at considerable cost, and though deposits have been found, production, so far, has been small. The local market is chiefly supplied by means of imports of crude oil.—*Board of Trade Journal.*

INCOME TAXPAYERS' SOCIETY.

An Income Taxpayers' Society has been formed with Lord Inchcape, G.C.M.G., K.C.S.I., K.C.I.E., as President, Sir William P. Treloar, Bart., Treasurer, and the Lord Decies, D.C., with the following objects:—

This Society has been founded to protect

and advance the interests of all payers of Income Tax, and amongst its objects are the following:—

1. To press for a reduction of the Income Tax as soon as the financial conditions of the country permit.

2. To press for redress of inequalities which specially affect the small Income Taxpayer.

3. To maintain the constitutional principle of control of the administration, assessment and collection of Income Tax by the taxpayers through the medium of their representatives, the Commissioners for the General Purposes of the Income Tax and their local officers.

4. To simplify the machinery of assessment by protecting the Income Taxpayer against the duplication and complexity of forms.

5. To watch suggested legislation and call attention to any proposed encroachments on the taxpayers' liberties.

6. To advise members on points of practice and to assist them generally.

7. To investigate cases of hardship and seek redress by all lawful means.

8. To seek to improve the incidence of Income Tax by advocating the abolition of anomalies.

9. To assist in approved test cases where a principle is involved affecting groups of Income Taxpayers.

The annual subscription for membership is as follows:—

For individuals, 5s. (minimum); for Corporations and firms, £1 1s. (minimum).

All enquiries and communications should be addressed to the Secretary, Income Taxpayers' Society, Iddesleigh House, Caxton Street, London, S.W.1.

SUGAR CANE WAX.

Amongst the constituents of the sugar cane there is a considerable percentage of wax which, when purified, resembles Carnauba wax, and is consequently valuable. This wax collects in the press filter scum often to the extent of 10 %. An average of 100,000 tons of cane would give 250 of wax in the scum from clarification. The only existing method to extract the wax is to dry the press cakes and treat them with benzine. Wax thus obtained is hard and brown like beeswax. A practical process to extract this wax would be of great interest, as markets could easily be found.—*Bull. Inst. Col. Marseille, No. 4,* 1921).

CARBON DIOXIDE AS A FERTILISER.

Objections made by Dr. Caasen against the use of this gas as a fertiliser are criticised as follows by Dr. Riegel in the *Chemiker Zeitung.*

I quite agree with Dr. Claasen, of course, in respect to utilisation of this gas, which could only be undertaken when waste gas containing sufficient carbonic acid is available and the fields are not too far away.

There are, however, a considerable number of cases where circumstances are favourable, either on a small or a large scale. I made my estimates with the greatest prudence, calculating not only the extra cost for fertilisation, but also labour due to greater crops, and I took a very low price for the potato, which, to-day, is tripled.

Taking the price as double for the potato, viz., 60 marks per 50 kilos (110 lbs.), we have, after deducting 20 %, a yield of over 100 %. However, I purposely omitted this exceptional yield, fearing I might be called over optimistic.

Claasen considers, in any case, that the gassing of very large areas (several hectares) is relatively more expensive than small, but there is no foundation for such an opinion. The cost of pipes increases nearly in proportion with the diameter, but the capacity of utilisation of the pipes increases with the *square of the diameter. Consequently the* cost of the main pipe is less for large areas of soil and that of the branch pipes is also somewhat slighter.

For all these reasons the opinion expressed by Claasen that fertilising with gas, although the method has a theoretic or scientific value, is not practically possible, is absolutely erroneous, deceptive, and in contradiction with the teaching of experience. Moreover, this opinion is nullified by a subsequent statement that it would be possible to augment the economic yield by perfecting the method and plant. Evidently endeavours should be made to do so, the more so because carbonic acid fertilisation involves the maximum utilisation of waste heat which, in many cases, is only possible in this way. Many other ideas did not originate under more favourable auspices, e.g., the electric light industry, which has been improved technically and economically to such an extent that at the present day its use is universal. Had criticism been listened to at the outset, or facts neglected, electricity would never have developed to such a marvellous degree.

Considering that it has been practically and scientifically demonstrated that there is a gas which can increase the growth of plants twofold, is it right, at a time when vegetable products are so greatly needed, to remain idle, awaiting better times? Is it not a duty to gradually adopt such a system on an ever-growing scale?

In the meantime let me remark that at a meeting of the German Sugar Makers, Dr. Claasen spoke in favour of gas fertilisation. The difference in opinions seems simply to be in this, that Claasen maintains that we have no practical data respecting extensive applications, whereas Dr. Riegel advocates the use of gas in all places where circumstances favour subsequent development of the system.—*L'Engrais, Dec.* 16, 1921.

BELGIAN VARNISH SOLD AS BRITISH.

A reliable authority has reported to the Department of Overseas Trade the practice, on the part of certain sellers of varnish, of selling Belgian-made varnish as the product of fictitious firms, the reason, frankly admitted, being that there was a superior scope for the British product in this market. The experts, particularly the carriage builders, have, however, apparently penetrated the deception, and have been refusing all but the genuine British article, but the deception has been more successful in the provincial districts. Steps have been taken to put a stop to the practice, and exporters who have reason to suspect that their trade is being affected by any such procedure should immediately report the fact to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

PHARMACEUTIC PRODUCTS IN RUSSIA.

On June 1st, 1921, the Central Administration of Pharmaceutic Products had under their control 37 works, 10 in Moscow; 14, Petrograd, Central Russia and the Volga; 7, the Ukraine; 3, S.E. Russia; 1, Ural; 1, Crimea; 1, Turkestan. The works in the last-mentioned place produces about 500 poods (17,640 lbs.) of santonin yearly.

The Saky Works, Crimea, manufactured 2,500 poods of bromin per year, and that of Archangelsk about 400 poods of iodin works, especially at Tomsk, Ekaterinoslav, and on the banks of the White Sea and the Caucasus, but without success. There are hopes of being able to organise the manufacture of iodin in the Mourman district, on the peninsula of Ribatchy, where there is an abundance of sea-weed.

The Novotcherkassk Works extracts an average of 36 kilos of atropin yearly. The total pharmaceutic production is represented by 61,631 kilos from the Ukraine and Caucasus and 609,323 from the Moscow works. The remaining 90,281 kilos are supplied by other places. Moscow produces 80 per cent. of the total, chiefly in form of alkaloids and Salvarsan. Manufacture of alkaloids, bromin salts, quinine, cafein, camphor, is quite new in Russia, and has not developed as expected. In addition to scarcity of coal, and other difficulties due to the critical situation, it is often impossible to find the medicinal plants required. Then there are not sufficient bottles, receptacles and packing cases.

Nevertheless, if we may believe the Soviet statistics, the Russian pharmaceutic production has made progress, though slow, during the past few years.

"Chemie et Industrie," Nov., 1921.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Comptés Rendus Hebdomadaires des Séances de l'Académie des Sciences Vol. clxxiii., No. 25, December 19, 1921.

The Precipitation of Lime with Precipitates of Ferric Oxide.—M. A. Charrion.—M. Toporescu (C. R., clxx., p. 125) has studied the variation in the weight of lime carried down by ferric oxide as a function of the concentration of the solutions in ferric chloride and calcium chloride. The weight of lime carried down seems to be a function of the concentration of lime existing in the saline solution at the moment of the precipitation of the ferric oxide with ammonia. The excess of ammonia giving in presence of calcium chloride the following equilibrium:—

$$CaCl_2 + 2\ NH_3 + 2\ H_2O = 2\ NH_4Cl + CaO\ H_2O.$$

According to the law of mass action the

to vary in the same sense as those of the calcium chloride and ammonia and in the opposite sense to that of the ammonium chloride. The author has carried out a series of experiments in order to verify these conclusions, and has found that his results agree with those of M. Toporescu, as regards the inference of calcium chloride, for low concentrations. The weight of lime carried down first increases with increasing proportions of ammonia, passes through a maximum and then decreases. The existence of this maximum seems to be due to *the formation of an addition product* of ammonia and calcium chloride, favoured by the high concentration of ammonia in the solution. The weight of lime carried down diminishes slowly as the concentration of ammonium chloride increases. Thus in order that as little lime as possible may be carried down the concentration of the calcium chloride must be kept down, and the minimum quantity of ammonia must be nsed to precipitate the ferric oxide.

Halogen Derivatives of Indigos.—M. Grandmongin.—The author has shown that, as was to be expected on theoretical grounds, in the series of chloro derivatives of *indigo octo chlor indigo is* more *violet* than the 5.7.5'.7'. derivative and than pent a o hexachlov-indigo. The redness of the colouration is caused by the appearance of a new absorption band in the green region of the spectrum. This absorption destroys the green tinge which would otherwise be caused by the displacement of the principal ray in the red region of the spectrum. 5.7.5'.7'. tetrachlor-indigo is more violet than the corresponding bromine compound, chlorine having a less bathochromic influence than bromine, which produces less colouration than iodine. The study of the halogen derivatives of indigo shows that there are still certain difficulties to be overcome before the shade of new compounds and their tinctonal properties can be accurately foretold.

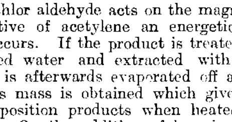
Catalytic Hydrogenation of Polyphenols in the Wet Way.—J. B. Senderens and J. Abouienc.—*If attempts are made to hydrogenate* resorcine in the wet way it is found that at 200° and a high pressure decomposition products are chiefly obtained, while at a low temperature and pressure no hydrogenation occurs, even when the constituents are well shaken. The authors have succeeded in reducing the polyphenols under a fairly high pressure and at as low a temperature as possible, meanwhile shaking thoroughly, and in four hours can convert 1 kg. of resorcine in solution in alcohol or water into 1.3. cyclohexanediol. Similarly they have easily effected the total reduction of pyrogallol, pyrogallol, phloroglucine and oxyhydroquinone.

Derivatives of Acetylenic erythrite $CH_2OH. CHOH \equiv C.CHOH\ CH_2\ OH.$—M. Lespieau.—When the dichlor ether $CH_2Cl. CHCl. O.C_2H_5$ reacts within the di magnesium derivative of acetylene a liquid of formula $CH_2Cl.—CH—C \equiv C—CH—$

1 1

OC_2H_5 OC_2H_5

$CH_2Cl.$ is obtained, and this liquid is a mixture of an inactive and a racemic substance, for on the addition of two atoms of bromine two different isomers are formed which do not appear to be cis and trans isomers. It might be thought that it would be easy to pass from these ether oxides to the corresponding glycols, but this has not been found to be the case. When monochlor aldehyde acts on the magnesium derivative of acetylene an energetic reaction occurs. If the product is treated with acidified water and extracted with ether which is afterwards evaporated off a black viscous mass is obtained which gives only decomposition products when heated in a vacuo. On the addition of bromine, after the lapse of several months it was observed *that crystals had formed, and in the course* of some years enough of these bad accumulated to be investigated. They are monoclinic crystals, melting at 141°—142.5°, and their composition correspoads to the formula $CH_2Cl. CHOH. CBr.=CBr. CHOH. CH_2Cl.$ When potassium is added to the viscous mass, mentioned above, after treating it with ether heat is generated and a brackish precipitate is formed, the ether becoming clear. If the ether is decanted off and distilled under reduced pressure a colourless oil is obtained, and analysis shows that its composition is very approximately that of the dioxide



Although the boiling point is constant it is possible that this oil is a mxture of stereoisomers, and the author is pursuing its investigation.

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

[O]RDINARY MEETING, DEC. 8, 1921.

[P]ROF. C. S. SHERRINGTON, President, in the Chair.

The following Papers were read, the summaries here printed having been supplied [by] the Authors for use at the meeting:—

LORD RAYLEIGH, F.R.S. A Study of the [Gl]ow of *Phosphorus.—Periodic Luminosity* [an]d Action of Inhibiting Substances.

The paper deals with the intermittent or [pe]riodic luminosity observed to be propagated through the gas space when the last [tra]ces of oxygen are being removed from air [by] means of phosphorus, or when air is [all]owed slowly to leak into an exhausted [ve]ssel containing phosphorus.

(1) It is shown that this effect, as ordin[ar]ily observed, requires the presence of [wa]ter vapour. Moderate drying (*e.g.*, by [su]lphuric acid) makes the glow perfectly [st]eady. Water vapour has therefore the [po]wer of inhibiting the combination of phos[ph]orous vapour and oxygen within certain [li]mits. When the composition of the mix[tu]re becomes favourable beyond those limits [a] wave of combustion is propagated.

(2) Other substances are known to in[hi]bit the glow of phosphorus. Some of [th]ese can be used to exhibit the above phe[no]mena in a far more striking form than [wa]ter. Camphor, ammonia and pear oil [ar]e among the most effective, and experi[me]nts with them are described in detail.

(3) It is shown that the propagation of [th]ese waves of combustion cannot be attri[bu]ted to the rise of temperature of one layer [ig]niting the next layer, for the rise of tem[pe]rature is too small. An alternative theory [of] the propagation is proposed, which as[su]mes that it depends on the provision of [nu]clei, as in the propagation of crystallisa[tio]n through a supercooled liquid.

(4) On this basis a theory of the action of [th]e inhibitors (sometimes called "negative [ca]talysts") is developed.

LORD RAYLEIGH, F.R.S. The Aurora Line [in] the Spectrum of the Night Sky.

(1) The spectrum of the night sky at Ter[lin]g (not far from London) has been photo[gr]aphed systematically. The aurora line at [wa]ve-length 5578 is recorded on about two [ni]ghts out of three.

(2) Its intensity on ordinary nights does [no]t seem to be obviously related either to [th]e amount of magnetic disturbance, or to the transit of spots over the sun's central meridian.

(3) The intensity in the neighbourhood of Newcastle is notably less than near London, thus the effect appears to increase towards the south. It would seem, therefore, to be due to some different cause from the Polar aurora.

(4) It is confirmed that the aurora line does not coincide with krypton. Some experiments to determine its origin are described, but the results are negative.

E. F. ARMSTRONG, D.Sc., F.R.S., and T. P. HILDITCH, D.Sc. A Study of Catalytic Actions at Solid Surfaces. VII.—The Influence of Pressure on the Rate of Hydrogenation of Liquids in presence of Nickel.

The comparative rates of absorption of hydrogen at different pressures by a variety of unsaturated compounds in presence of nickel have been studied, and it is found that the relation between the hydrogen pressure and the rate of hydrogenation is dependent on the type of organic compound which is examined.

Simple ethylenic compounds are hydrogenated, in presence of sufficient nickel, at rates which are in almost exact proportion to the absolute pressure of the hydrogen.

At very low concentrations of catalyst (*e.g.*, 0.01—0.02 per cent. of nickel reckoned on the organic compound) the increase in rate of hydrogenation becomes less than proportional to the increase in pressure, an effect which is especially marked in the cases of multi-ethylenic compounds such as linolein or citral.

If the unsaturated compound contains another group which has affinity towards nickel (but is not open to hydrogenation), increase in hydrogen pressure causes an increase in the rate of hydrogen absorption in more than simple proportion to the altered concentration of hydrogen.

Unsaturated compound.	*Effect of pressure.*
Ethylenic hydrocarbons or esters	Normal
Ethylenic alcohols	Abnormal
Ethylenic aldehydes or ketones ...	Normal or subnormal
Ethylenic acids	Abnormal

These results are shown to be in harmony with the authors' theory that catalytic hydrogenation is primarily conditioned by an association of the ethylenic linkage with the catalyst, the latter being also associated with hydrogen.

W. D. WOMERSLEY. The Energy in Air, Steam and Carbon Dioxide from 100°C. to

2,000°C. Communicated by Sir Dugald Clerk, F.R.S.

The *paper gives the results of experiments* carried out *early* in 1919 with the Hopkinson Recording Calorimeter for Explosions. The combustible gases exploded in the experiments were hydrogen and carbon monoxide mixed with either air or oxygen. *Curves showing the energy in the* various gases and also the mean volumetric heats from 100°C. to 2,000°C. are given. The values are found to be, where comparable, about 7½ per cent. higher than those of *Holborn* and Henning.

The *difficulty* in estimating the heat *liberated in a closed-vessel explosion experienced* by Hopkinson was found to be due probably to a spontaneous time reaction between the combustible gas and oxygen when the two are mixed, and about 10 per cent. of the gas was found to be consumed, on this account, *previous to the actual explosion.*

The combustion of carbon monoxide was found to be considerably slower than that of hydrogen, and even one second after ignition there was still present in the calorimeter a considerable amount of unburnt *carbon monoxide. This fact made the esti*mation of the heat liberated in the carbon monoxide experiments very uncertain. There seems to be no reason why this phenomenon should not have occurred in the experiments of other workers, but it is not *mentioned* by them as in any way affecting their results.

An appendix is given showing the results of experiments carried out with the calorimeter on the rates of heat-flow to the walls, with the latter both polished and blackened.

Lieut.-Col. J. W. Gifford, F.R.A.S. Atmospheric Pressure and Refractive Indices, with a Corresponding Table of Indices of Optical Glass. Communicated by Sir Joseph Petavel, F.R.S.

Under a special method, previously described, more accurate results were obtained and a correction for temperature introduced. Later it was felt that the greater accuracy had been *only partially achieved*. There remained to be dealt with a correction for pressure. It had been pointed out that the modulus of rigidity for glass precluded its being sensibly affected by pressure, and that therefore any such effect must be due to air *alone.*

Similar formulæ for the variation of the refractive index of air with temperature at given pressure have been given by Benoit and by Mascart. The index for air at standard pressure and 0°C. given by Benoit is the mean of that given by a number of *other observers. Adopting this and the* mean of the constants given by Benoit and Mascart, we have—

$n_0 = 1.0002923$ at standard pressure (760 mm.) $n_t - 1 = \dfrac{n - 1}{1 + 0.00374t}$

The application of this formula for *correction is as follows*:—

Let

P = standard pressure

p = observed ,, in mm. of mercury.

n = refractive index of air at standard pressure and observed temperature.

$1 + \dfrac{(n-1)\,p}{P} = n'$ = *refractive index of air at* observed pressure and observed temperature.

μ = refractive index of substance at observed pressure and observed temperature.

μ = *refractive index of substance at* standard pressure and observed temperature.

From this and two measurements of refractive index of same wave length, at different temperatures, the *refraction temperature coefficient at standard pressure for* 1°C. is determined. Using this coefficient as a final correction, indices for other wavelengths at standard pressure and observed temperature may be brought to standard pressure and temperature (15°C.).

Worked examples, a *table of corrected* refractive indices, and a list of corresponding temperature refraction coefficients follow.

H. P. Waran. A New Form of Interferometer. Communicated by Prof. H. F. Newall, F.R.S.

The paper describes briefly the results of some successful experiments conducted under great experimental difficulties at Madras to test the practicability of employing a thin layer of transparent liquid floating over *mercury as a parallel plate* interferometer—a substitute for Lummer and Ghercke's glass plate. The employment of ciscous castor oil proved the success of the idea, but its poor transparency stood in the way of securing high revolving power. The disturbing influence of the tremors of the ground was overcome by mounting the trough on a float suspended from the ceiling in a tank of water carried on a massive brick pillar with deep laid foundations in the

cellar of the laboratory. The advantages of such a form of interferometer are briefly stated. The fringes obtained are found to be quite sharply defined and suitable for refined measurements.

H. Harle, A.R.C.S., B.Sc., D.I.C. On the Viscosities of the Hydrogen Halides. Communicated by Prof. H. L. Callendar, F.R.S.

The paper describes an experimental determination of the coefficients of viscosity of the gaseous hydrogen halides, undertaken with a view to affording a check upon the theoretical investigation by A. O. Rankine (Proc. Phys. Soc., 1921) on the diameters of unsymmetrical molecules.

The method of continuous transpiration through a capillary tube is used, the constant in the expression for being determined, using the known data for air. The gases are liquefied, and, by a means of controlling the evaporation, establish their own steady pressure while transpiring through the tube, the pressure difference being read on a U-tube gauge with a suitable liquid. The volumes of gas passing in a given time are arrived at by absorbing in water and titrating with standard alkali solutions, using the known density of the gas in the case of HCl, while for HBr and HI separate experiments were made to determine the density under conditions identical with those of the viscosity experiments.

Values of were obtained at two temperatures, round about 15 and 100°C., and from them Sutherland's constant of temperature variation is calculated for each of the gases.

INSTITUTE OF CHEMISTRY OF OF GREAT BRITAIN AND IRELAND.

PASS LIST.

Examinations: January, 1922.

The following candidates have been successful in the recent Examinations and have been duly elected Associates of the Institute:

Examination in General Chemistry.

Crossingham, John Harold.
Hyland, John Lawrence.
Randall, Frederick Charles, B.Sc. (Lond.).
Stevenson, Samuel Gordon.

Examination in Organic Chemistry.

Brazier, William Ernest.
Cuckney, Malcolm.
Dorrick, William.

E[illegible]ination in the Chemistry of Foods and Drugs, etc.

Wright, Neville Lushanus, D.I.C.

[illegible]

cessful in the Examination and have been duly elected Fellows of the Institute:

Examination in Inorganic Chemistry (Section II.), Metallurgy.

Scholes, Alfred.

Examination in Agricultural Chemistry.

Arnold, Charles William Brown, B.Sc. (Lond.).

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922.

FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

February 3.—Lieut.-Colonel Sir Francis Younghusband, K.C.S.I., K.C.I.E.—"The Mount Everest Expedition."

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—"The Teeth of the Nation."

February 17.—Dr. S. M. Watson, MSc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—"History of the Mammalian Ear."

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

January 28.—Dr. C. Macpherson—"The Evolution of Organ Music."

January 31.—Prof. H. H. Turner—"Variable Stars."

February 2. — Sir Napier Shaw—"Droughts and Floods."

ROYAL INSTITUTION.—Next Tuesday (Jan. 31) at three o'clock Professor H. H. Turner begins a course of three lectures at the Royal Institute on Variable Stars; on Thursday (Feb. 2) Sir Napier Shaw delivers the first of two lectures on " Droughts and Floods," and on Saturday (Feb. 4) Dr. E. de Selincourt commences a course of two lectures on " Humorists of the Seventeenth Century ": 1, Sir Thomas Browne; 2, Thomas Fuller. The Friday Evening Discourse on February 3 will be delivered by Sir Francis Younghusband on the " Mount Everest Expedition," and on February 10 by Dr. Halliburton on the " Teeth of the Nation."

New Patents.

THIS list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks and Designs can be obtained gratuitously.

Latest Patent Applications.

357—Bonnafoux, B. L.—Process to improve Bessemer, acid, or basic steel. Jan. 5.

363—Chemische Werke vorm Auerges.—Processes for producing pure titanic acids from titanic ores. Jan. 5.

441—Douglas, R. P.—Manufacture of sulphate of ammonia. Jan. 6.

567—Elektriztatswerk Lonza.—Process for improving electrolytic mercuric oxide. Jan. 7.

474—Imray, O. Y.—Manufacture of dye-stuffs from anthraquinone. Jan. 6.

277—Kirby, E. B.—Metallurgical furnaces. Jan. 4.

172,993—Wallis, R. L.—Production of organic compounds adapted for use as antiseptics and processes of sterilization, disinfection, and the like.

173,004—Adam, M. A.—Production of butyric aldehyde and butyric acid therefrom.

158,531—Surpass Chemical Inc.—Process of dyeing.

173,060—Reed, C. J.—Processes for making sulphuric acid.

173,063—Imray, Y. O.—Manufacture of soluble derivatives of camphoric acid.

153,006—Ges Landwirtschaftlichen Bedarf and Mandelbaum, R.—Treatment of gas liquor in order to extract a fertilizer therefrom.

Abstracts Published this Week.

Zinc Lead.—Patent No. 171,722.—A method of treating Zinc Lead ores has been patented in this country by Mr. C. E. *Cornelius*, of 22, Narvavagen, Stockholm. The vapours from a zinc reduction furnace are highly cooled, for example, to approximately 60 to 70°C., by means of cooled channels, tubes, etc., whereby the whole of the zinc is condensed to powder form and the reduction gases escape through an outlet. The zinc powder, protected from contct with air, is conveyed to a furnace from conversion to the liquid state. Zinc and lead are obtainable in this way from ores containing both metals.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each.

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the MANAGER.

BACK NUMBERS and VOLUMES can be purchased on application to the MANAGER.

THE CHEMICAL NEWS,
97, SHOE LANE, LONDON, E.C.4.

ADVERTISEMENTS.

All communications should be addressed to—

ADVERTISEMENT DEPARTMENT,
63, LUDGATE HILL, LONDON, E.C.4.

CHEMICAL ASSISTANT. — Applications are invited for temporary employment as a Chemical Assistant in the London County Council Public Health Department at a rate of pay of three guineas a week plus temporary additions subject to periodical revision. As far as can be estimated at present the total weekly remuneration as at 1st March, 1922, will be about £5 13s. 0d. Candidates (who may be of either sex) must be natural-born British subjects unless they served with H.M. Armed Forces during the War, and not less than 25 or more than 40 years of age, and must furnish evidence of thorough training in *chemistry and allied sciences.*

Preference given to candidates who have served or attempted to serve with H.M. Forces, and particularly to disabled men.

Application (in writing), stating qualifications, experience, War service (if any), etc., should be addressed to the Clerk of the Council, County Hall, Spring Gardens, S.W.1, and should reach him not later than 11 a.m. on Monday, 6th February, 1922. Canvassing disqualifies.

GOVERNMENT LABORATORY. — Temporary Assistant Chemists required. Age 20-25. Qualifications, B.Sc. with not less than 2nd Cl. Hons. or equivalent. Salary, Men £160-£10-£220, Women £140-£10-£180, plus usual Civil Service bonus. At present £160 is equivalent to £319 18s., but this will be revised on 1st March.—Apply, with copies of testimonials, Government Chemist, Clement's Inn Passage, W.C.2.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3225.

THE INFLUENZA EPIDEMIC.

PRESENT VISITATION PANDEMIC. PRECAUTIONS TO BE TAKEN.

1.—The Ministry of Health issues the following statement as to the present position, based on information obtained by its medical staff since December last.

2.—Outbreaks of influenza in England began in November, notably in the western areas of Nottighamshire, whence it spread to towns in the south of the West Riding (where Leeds, Sheffield and Rotherham were principally affected) and westwards towards the Potteries. In the areas thus attacked early the epidemic has now materially abated or practically ceased. In London, although there was evidence of influenza in the schools about the end of November, the disease did not become generally prevalent until the middle of the following month. The northern, southern and eastern Registration Districts of London have been those mainly affected. During the last fortnight the epidemic has further extended, and the disease is now widely prevalent in many parts of England and Wales. In the 96 great towns, during the week ending 14th January, the deaths from influenza (including bronchitis and pneumonia complicating influenza) totalled 1,240. Of this number 551 occurred in London. During the same week the deaths in London attributed to pneumonia (without mention of influenza) rose from 318 to 457, and those attributed to bronchitis from 282 to 394.

Weekly returns from the towns where the wave has now apparently spent its force suggest a duration of the epidemic in individual areas of 6 to 7 weeks. This fact, and the slackening rate of increase in London, encourage the hope that the epidemic in the metropolitan area is at or near its maximum.

3.—The epidemic on present evidence may be classed with those which occur with some regularity in the years which follow a great pandemic. It bears the same relation in time to the pandemic of 1918-1919 as the recrudescence of 1895 bore to the severe epidemic of 1892—the most fatal of the three waves which affected London in the pandemic period 1889 1892. As compared with the 1918-1919 period the number of persons now being attacked is smaller, and the severity of the disease is usually much less. In this connection the figures already given may be compared with those of the week of maximum incidence in 1918, when there were 7,557 deaths in the 96 great towns, 2,458 of which occurred in London.

4.—Epidemic influenza varies notoriously not only in its severity, but in the symptoms by which it is characterised. In ordinary cases during the present prevalence the attack takes the form of two or three days' fever. The acute catarrh of an ordinary heavy cold is by no means general. The most frequent symptoms are sudden onset, headache, pain in the back and legs and congestion of the throat, with some bronchial catarrh and an irritating and very persistent cough.

Most of the deaths attributed to influenza have been due to pulmonary complications, although these complications in the young adult and persons of early middle age are occurring far less frequently than in the pandemic years of 1918-19.

Stress may again be laid on the importance of persons attacked by influenza at once going home to bed, keeping warm, and obtaining necessary medical and nursing treatment. Special care should be taken to guard against the risk of broncho-pneumonia in young children, who, when attacked by influenza, should be kept at home in a warm room until the symptoms are over.

It must be realised that for most people leading an active life it is difficult, if not impossible, to avoid infection. As a preventive measure throat gargling and particularly nose washing (insufflation) every night and morning may be adopted, the most useful solutions being potassium permanganate 1 in 5,000 parts (4 or 5 crystals of permanganate of potash and a teaspoonful of salt to a pint of warm water) or liquor sodæ chlorinatæ (20 drops to a tumbler of warm water). It does not appear that available influenza vaccines prevent attacks of influenza, but their judicious and timely use gives material security against the more dangerous complications, particularly pneumonia, which may result from an attack.

BIRMINGHAM UNIVERSITY.

[Personal.—The Council of the University of Birmingham report to the Court of Governors, who will hold the annual meeting on February 9, that in order permanently to associate the name of Professor Percy Frankland, F.R.S., D.Sc., with the Chemical Department of the University, and to commemorate his eminence as a worker in chemical science, a fund has been subscribed to provide a Frankland medal and prize of books, to be awarded annually to the best student of practical chemistry.]

The Council of the University of Birmingham, in their annual report to the Court of Governors, state that owing to the increase in the number of students the work at the Mason College Buildings of the University (in central Birmingham) is too congested, and there is great need for additional laboratories, lecture theatres, and classrooms. Where laboratories were concerned, their insufficient size frequently required duplication of classes, and even then the space available was quite inadequate. If it were possible to transfer the three biological departments (zoology, botany and the school of brewing and bio-chemistry) to the new University buildings at Edgbaston, considerable relief would be afforded, but this proposal raises large questions of finance, which have yet to be considered. Touching on the question of Research, the Principal (Mr. Grant Robertson) points out that the Joint Standing Committee of Council and Senate for organising and promoting the Research had been definitely set up, and had already done admirable work. On its advice, two important exploratory investigations, inaugurated by Government Departments, had been accepted, in addition to many other investigations already in hand. He was confident this committee had a great future in co-ordinating, inaugurating and encouraging research in all the faculties which in many cases would have a direct bearing on the industrial efficiency and prosperity of the Midlands. A matter for satisfaction was the transfer to the Birmingham University of the Coal-Owners' Association's Mining Research Laboratory. Not the least satisfactory feature of the transfer was the Association with the University (as hon. professor and director) of so distinguished an expert as Dr. J. S. Haldane, F.R.S., together with his expert assistant director, Mr. Ivor Graham. Owing to the demands made upon it by various Departments (particularly those of Mining and Petroleum Engineering) the geological staff required strengthening. The Principal also points out that the biological sciences had reached a point at which their application to health, to agriculture, to industry, to imperial development and to education was increasing daily, but the value and contribution of "applied" Biological science would be largely determined by the advance in "pure" biological science. Was the University of Birmingham, he asked, to have its proper place and share in this development?

The Mutual Action of Adjacent Photographic Images, *Astrophysical Journal*, 53, 349-374, June, 1921. The University of Chicago Press, Chicago, Ill. By Frank E. Ross.

ABSTRACT.

Mutual action of adjacent photographic images. (1) *Stars and bright lines.* A review of previous work shows that the results are so conflicting that general conclusions cannot be drawn. Three factors seem to control the action. The *turbidity effect* causes an attraction through optical reinforcement of adjacent sides of the images. An equation is derived from which the attraction is found to be negligible, except for very small images very close together. The *gelatine effect* causes an attraction due to the more rapid drying of the developed image. It is measured by the difference in the separation of images when wet and when dry. For normal exposures of star images less than 0.1 mm apart the attraction is equal to about 2μ for ordinary developers excepting pyro-metol, while in the case of lines the attraction is about 5μ. This attraction is only slightly changed by varying the amount of sulphite or by the use of a hardener. The *developer or Kostinsky effect* causes a repulsion as a result of the restraining effect of the products of the developing reaction, as in

the Eberhard effect. It varies somewhat with the developer, but increases with the exposure. The *variation of the total effect with exposure* is such that overexposed images show strong repulsion due to the large developer effect, whereas normally exposed images show an attraction which usually amounts to 2 or 3 μ. To minimise the error which the effect may introduce into measurements of such images, the exposure should be as short as possible. The phenomenon is so complicated that it may be impossible to eliminate it completely. (2) In the case of *absorption lines*, both the gelatine effect and the developer effect cause a repulsion, but in addition to the attraction due to the turbidity effect there is a further attraction due to a difference in the sharpness of outer and inner edges caused by turbidity and halation. In general the total effect is an attraction, about 1 μ for normal exposures, but larger for overexposures. Seed 30 plates were used.

Effect of exposure on the time of drying of photographic film. A normally exposed image dries faster than an underexposed or an overexposed region.—GORDON S. FULCHER.

The Spectrum of Fluorine, *Astrophysical Journal*, 54, 133-139, September, 1921. The University of Chicago Press, Chicago, Ill. By William R. Smythe.

ABSTRACT.

Preparation of fluorine gas by electrolysis of fused potassium acid fluoride. — The method due to Mather and others of the Chemical Warfare Service is described, together with the necessary apparatus. The gas was purified by passing through sodium fluoride and a freezing trap. To protect the pump a charcoal trap was inserted.

Visible and ultra-violet spectrum of fluorine and carbon tetrafluoride.—A dozen previous researches had failed to determine definitely the lines due to fluorine because of impurities in the gas used. In this research a spectrum with foreign lines absent or very weak was obtained by flowing practically pure fluorine gas at atmospheric pressure continuously through a discharge tube with gold electrodes. Although the tube had a fluorite window, put on in optical contact without cement yet practically air-tight, and both a quartz spectrograph and a 50 cm concave grating were used, the only fluorine lines found were ten between λ 6239 and λ 7034. The *wave-lengths* of these lines, determined to about 0.1 A, are given, and also the approximate positions of the heads of nine bands presumably due to CF_4, between λ 4829 and λ 6525.—GORDON S. FULCHER.—Issued by the University of Chicago Press.

GEOLOGICAL SOCIETY OF LONDON.

ABSTRACTS OF THE PROCEEDINGS.

December 21st, 1921.

Mr. R. D. Oldham, F.R.S., President, in the chair.

The following communications were read:—

1. "The Nature and Origin of the Pliocene Deposits of the County of Cornwall and their bearing on the Pliocene Geography of the South-West of England." By Henry Brewer Milner, M.A., D.I.C., F.G.S.

The author discusses the petrography of those Tertiary deposits of Cornwall which, by reason of similar mode of occurrence and lithological resemblance to the well-known fossiliferous beds of St. Erth, have been provisionally assigned to the Pliocene Period. Such deposits occur at St. Agnes, St. Erth, Lelant Downs, Polcrebo, and St. Keverne; except those of St. Erth, all are unfossiliferous.

By petrographic methods of correlation, using St. Erth as a type-locality, the relative age of the St. Agnes and St. Keverne beds is established. At Lelant Downs no deposit occurs *in situ*, but scattered blocks of an indurated furriginous grit are found at an elevation corresponding to that of the St. Erth beds on the opposite side of the valley, and a potential relationship is accordingly admitted. The Polcrebo gravels differ from the other deposits, and are referred to a later period.

The average composition of the St. Agnes, St. Erth, and St. Keverne deposits is shown to be substantially the same, the important "heavy" minerals common to all being magnetite, ilmenite, tourmaline, staurolite, epidote, zircon, anatase, rutile, topaz, andalusite, and cassiterite; garnet was found only at St. Erth, kyanite at St. Agnes and St. Erth. On this basis, correlation of the deposits is effected by considering (1) the frequency of occurrence of individual species; (2) their persistence or distribution; and (3) the constancy of crystallographical, physical, and optical properties of grains of the same mineral, wherever met with.

The source of the material is essentially local, although kyanite and staurolite are "foreign" species; the former, from its striking Lower Greensand habit and absence from St. Keverne, is thought to be derived from the north-east, the latter from a landmass lying on the south, probably united to Cornwall and Devon in late Miocene times, before early Pliocene submergence set in. The gradual "swamping" of sediment-bearing rivers by the advancing Pliocene sea from the south-west is correlated with certain physical features apparent, especially the "400-foot plateau."

DISCUSSION.

Prof. P. G. H. BOSWELL welcomed the paper as a contribution to our knowledge of the petrology of the Tertiary deposits of the West of England. The author's records of the characteristic minerals were confirmed by the speaker's own identifications. It was a noteworthy but unexplained fact that, while the Permian, Trias, Lias, and Inferior Oolite strata of the West of England were characterised by an abundance of garnet, that mineral was absent from or extremely rare in the Cretaceous, Eocene, Oligocene, and Pliocene of Devon and Cornwall, although it was a common constituent of the Palæozoic rocks of Devon, Cornwall, and Brittany.

He enquired why the author desired to have the staurolite in the St. Keverne sands derived from the old "Armorican" land on the south-west, unaccompanied by its usual associate, kyanite; while, in the case of the sands at St. Agnes and St. Erth, he assumed a Lower Greensand origin in the north-east for the same two minerals. The absence of kyanite at St. Keverne seemed to be inconclusive in the matter of the derivation of the material.

The paper was valuable for the additional light which it threw upon early Pliocene geography. The author's conclusions, although novel, were not necessarily inconsistent with our ideas of the distribution of Pliocene land obtained from a study of the fauna of the St. Erth clays and the Crags. That the migration of southern species into the North-Sea basin over what is now the English Channel and Kent was possible in early Pliocene times, but was prevented during the deposition of the Middle and Upper Pliocene, presumably by the raising of a land or shallow-water barrier, is indicated by the molluscan faunas; further, the totally different character of the mineral assemblages of the Cornish and East Anglican Pliocene (the latter having apparently been derived from the south-east) supports the view. Moreover, the similarity in certain mineralogical respects (notably in the rarity of garnets) of the Lenham Beds and the Cornish Pliocene may prove to be more than mere coincidence.

Mr. G. M. PART said that he had hoped that this paper might suggest some reasonable source for the very similar assemblage of minerals found in some of the Glacial drifts of Pembrokeshire, which it could only be surmised were derived from some similar Tertiary deposit. As the Pembrokeshire drifts were derived from a westerly or north-westerly direction, this would involve a northern drainage if Cornwall had provided any of the material for a deposit from which the blood-red pleochroic andalusite had found its way into the gravels.

Dr. H. H THOMAS agreed with the author that the kyanite of these deposits was most probably derived from sediments of Cretaceous age. The absence of kyanite from the western New Red rocks was strong evidence in support of the author's view. He thought that the grains of staurolite with frayed-out cleavages owed this distinctive character to their derivation from large crystals. This was the conclusion to which he had come from a study of the abundant and large grains found in the Western Trias. With regard to the great similarity between the mineral assemblages of the Cornish Pliocene and the drift-sands of Pembrokeshire, he had many years ago sug-

gested the latter's partial derivation from Tertiary deposits occupying, in Glacial times, a position in the bed of the Irish Sea.

Mr. G. Barrow was greatly interested in the author's work, as it dealt with what are commonly known as Pliocene deposits, now occurring at heights much above sea-level. The Geologists' Association had taken a special interest in these high-level deposits, which occurred in patches extending from the south-east of Kent at least as far as the neighbourhood of the Guildford gap in the Chalk. Apart from the Lenham Beds, fragments of undoubtedly marine shells have been found in the gravels of Headley Heath. The mode of occurrence of these is important, as it suggests where to look for further casts. They occur only when the sand surrounding the original shell-fragments has been firmly cemented by iron-oxide, and nowhere else. The examination of the deposit on the ground suggests that these gravels are beach-deposits, with broken shell-fragments once common in them. All these fragments have been dissolved; but, where iron-oxide filtered in and cemented the sand before solution took place, casts of some fragments are preserved. It is in such cemented patches that we must in future look for evidence of the age and nature of these beds; this knowledge not only shows where to look, but where it is useless to look, and this so far covers more than 90 per cent. of the whole.

Mr. T. Crook said that it was particularly pleasing to note the emphasis laid on sampling. Failure to record a mineral in such deposits did not necessarily mean that the mineral was absent; but, with careful sampling, such as the author appeared to have carried out, much better results were likely to be obtained than when records were made on specimens collected haphazard. It seemed to the speaker that it would be very useful if the author would include in his paper an account of the method of sampling adopted, so that other workers might be able to obtain results that were fairly comparative.

With regard to the mineral composition of the sediments described, it was perhaps worth while to enquire whether the relative amounts of such minerals as garnet, staurolite, and kyanite, which were all metamorphic minerals in the ordinary sense, and might have emanated from the same ulti- was from other sediments, and where consequently the minerals had suffered repeatedly from the action of processes incidental to detrital sedimentation, possibly under a wide range of climatic variation.

Dr. J. W. Evans thought it improbable that the relative level of land and sea changed to the same extent throughout the area concerned. He did not believe that material could have been transported from the north-east by coastal wave-action. On the northern coast of Devon and Cornwall it was the north-westerly winds that produced the most important transporting action, and the movement was from south-west to north-east not *vice versa*. If the kyanite had travelled from the Lower Greensand of the neighbourhood of Devizes, it must have been by means of river-action, when the Bristol Channel was a tract of alluvium and Devon and Cornwall were at a relatively low level.

Mr. R. B. Newton declined on palæontological grounds to accept a Pliocene age for the St. Erth deposits. His own studies (see Journ. Conch. vol. xv, 1916) of the shells from those beds were all in favour of their Upper Miocene horizon, and as exactly the same facies was apparent among the Lenham mollusca, he was of opinion that the St. Erth and Lenham Beds were of contemporaneous origin. He mentioned the occurrence of similar species of shells in the Gourbesville deposits of Normandy which had been described by M. Gustave Wollfus (Bull. Soc. Géol. Normandie, 1880, and C. R. Assoc. Franç. Av. Sci., Cherbourg, 1906, pp. 358-70), and referred to the Redonian stage of the Miocene, which is considered the equivalent of the Upper Vindobonian horizon of Europe. The speaker was also of opinion that the palæontological evidence proved that the St. Erth, as well as the Lenham deposits, represented fragmentary remnants of the Continental Miocene development which extended from Holland, Denmark, Northern Germany, and Northern France.

The Author, in reply to Prof. Boswell, said that it appeared to him unlikely that the staurolite could have come from the north-east, in view of the absence of kyanite from St. Keverne; if both the minerals had been derived from the north-east, kyanite should have penetrated at least as far as the staurolite, and it should appear with the latter at St. Keverne, which

Part, the Author said that he had noticed the resemblance of the andalusite from the Glacial gravels of Pembrokeshire to the Pliocene species, but there was little doubt in his mind that the source of the Pembrokeshire deposits was from the west, possibly from an area now covered by the Irish Sea. In answer to Mr. Crook, the Author discussed the methods of sampling in the field at equal intervals along the strike of the deposits, and at each change of the lithological facies in vertical sections. The Author agreed with Dr. Evans that probably Cornwall stood at a higher level in early Tertiary times than it does at present; he specially drew attention, however, to the distinction necessary between the Tertiary deposits now occurring on either side of Dartmoor. In reply to Mr. Newton's criticism of the use of the word "Pliocene" in connexion with these deposits, the Author said that this was essentially a palæontological aspect of the subject, and one which he did not feel competent to discuss; he had always been content to accept as a basis the admirable work of the late Mr. Clement Reid on the Pliocene deposits of Britain.

2. "The Phosphate Deposit of Ocean Island." By Launcelot Owen, A.R.S.M., A.R.C.S., F.G.S.

Ocean Island (lat. 0° 52′ S; long. 169° 32′ E.), in the Western Pacific Ocean, consists of a mass of terraced and dolomitized coral-limestone which rises to a height of 300 feet above low water, spring tide.

Its surface is almost completely covered by a capping of calcium phosphate of exceptional purity. This phosphate can be divided into three varieties.—(*a*) amorphous calcium phosphate, formed of the insoluble residue of the original guano; (*b*) detrital coral-limestone, converted into calcium phosphate by solutions leached from the guano; and (*c*) phosphatized coral *in situ*.

The dolomitized limestone base shows evidence of having suffered considerable subaërial and marine erosion prior to the deposition of the guano, this deposition having occurred during the final emergence of the island.

A detailed study of the composition of the deposit shows that the percentage of tricalcium phosphate ($Ca_3P_2O_8$) at any point varies in a remarkably regular manner, according to the position of the point of the island. So regular is this variation, in fact, but if the position and height above sea-level of any point are known, the percentage of tricalcium phosphate in the deposit at that point can be foretold with considerable accuracy.

The trend of this variation suggests that:—(*a*) the original guano was deposited on the coral base while a slow negative movement of the strand-line was in progress, and no sensible break occurred either in the deposition of the guano, or in the movement of emergence:—(*b*) subsequent to the deposition of the guano and its conversion into phosphate, the island was tilted at about a third of a degree south-southeastwards. This supposition is strengthened by the occurrence of raised beaches in the north of the island, and of phosphate *in situ* below sea-level on the south.

A study of similar deposits may help to throw some light on the post-Tertiary movements of the floor of the Pacific Ocean.

DICUSSION.

Mr. J. F. N. GREEN referred to the interest of the differential movement, proved, he thought, for the first time for one of the smaller limestone islands of the Pacific. There might be significance in the occurrence of thick deposits of phosphate-rock in the Pacific on 'high islands' only, whereas 'low islands' supplied inferior surface-material, presumably owing to shorter occupation by birds. Perhaps a short time ago, geologically speaking, the low-lying islands were under water, which would also account for the late arrival of Man.

The AUTHOR replied that most of the terraced limestone-islands of the Pacific have been noted as approximately 100 metres (328 feet), and Ocean Island conforms to the general rule. Apparently, however, no evidence of slight tilting has been noted before. The reason that all the deposits of any great value occur on such islands may be due to the very uneven surface which a platform of eroded coral offers, the guano being thus trapped in a way that would be impossible on the smooth surface of the low-lying islands. The reasons for the disappearance of the birds are obscure; but it may be noted that the really extensive and older phosphate deposits of the Pacific tend to occur in the west, while the smaller and more recent deposits are found mostly in the east.

Microscope-slides and lantern-slides were exhibited by Mr. H. B. Milner in illustration of his paper; and rock-specimens and lantern-slides by Mr. L. Owen in illustration of his paper.

GENERAL NOTES.

RADIUM IN BRAZIL.
DISCOVERY OF A NEW MINE.

Mrs. Alexander Grosse, F.R.G.S., has just returned from Brazil, from an expedition into the interior, where she discovered a radium mine (euxamite radio-active rare earth).

She is the first English (or American) woman to penetrate into these regions. At the base of the mountains is a medicinal lake used by the natives. This lake is radio-active.

Mrs. Grosse is at present in Paris in consultation with Madame Curie.

Times.

CHEMICAL TRADE WAGES.
EMPLOYERS' ULTIMATUM.

The Joint Industrial Council for the Chemical Trade met to consider the demands made by the employers for a reduction of wages of 3d per hour, as from February 1. Mr. Roscoe Brunner presided.

The workers' side contested the employers' demand, and urged that the reduction was not warranted, and even if there were grounds for a reduction, then to ask for an amount equal to 12s. a week was unjust.

The employers' representatives stated it was their intention to reduce wages by 2d. per hour on and from February 1, with a further reduction of 1d. per hour on March 1. The workers' side refused to agree, and the meeting broke up, the employers expressing the intention of imposing the reduction.

Times.

Dr. J. S. Haldaine, in a recent letter to *The Times*, drew attention to the danger of the use of water gas in domestic lighting on account of the high percentage of carbon monoxide, and suggests that in the interests both of the gas undertakings and of the general public that a thorough investigation should be made into the precautions needed in connection with increasing percentages of carbon monoxide in domestic gas. The results of such an investigation would prove of great value in avoiding future troubles.

THE INSTITUTE OF METALS.
IMPORTANT MEETINGS OF THE YEAR.

The annual meeting of the Institute will be held in London on March 8-9, when ten important Papers are to be presented for discussion ... livered on May 3 by Sir Ernest Rutherford, F.R.S., on "The Relation of the Elements."

The Autumn Meeting of the Institute will be held—for the first time—at Swansea on September 20-22.

Prevention of Corrosion.—The Institute of Metals has just issued a practical pamphlet of 32 pages giving in summary form the results of over ten years' research into the causes and prevention of corrosion in condenser tubes. The pamphlet, which is one that will appeal particularly to all engineers, can be obtained, price 2s. 8d. post free, from the Institute fo Metals, 14, Members' Mansions, London, S.W.1.

The Electric Furnace Spectrum of Scandium, *Astrophysical Journal*, 54, 29-44, July, 1921. The University of Chicago Press, Chicago, Ill.

Abstract.

Spectrum of scandium in arc and in electric furnace, λ *3015 to 6559 A.*—A highly purified sample of scandia, prepared by Sir William Crookes, was placed in a graphite boat in the tube-resistance furnace operated at usual low pressures. The relative *intensities* of 307 lines on grating spectrograms, obtained with the furnace at a temperature of 2,000, 2,250, or 2,600° C., and with a carbon arc containing scandia, are recorded in Table I., together with the *classification* of each according to its behaviour in furnace and arc. About 25 lines enhanced in the spark and 150 lines enhanced in the furnace are indicated by E and A respectively. The 29 arc-flame lines are all A lines but are scattered through temperature classes I. to III.; they cannot be due to oxidation, since none took place in the furnace. On the other hand, since the band lines are practically absent from furnace spectra, they are probably due to the oxide. These results are of great interest in *relation to solar and sun-spot spectra.* The A lines and low temperature furnace lines are absent or very weak in the solar spectrum, but are prominent in the sun-spot spectrum.

Zeeman effect for scandium lines in sun-spot spectra is largely and apparently uniform. Laboratory observations are lacking at present.

Observations as to chemical properties of scandium. — The scandia fused in the furnace seemed to form a carbide with the graphite boat. The shining black residue turned to a gray-brown powder after exposure to the air, presumably from the

MINISTRY OF AGRICULTURE AND FISHERIES.

LIQUID MANURE TANKS.

A Dressing of 1,500 gallons of Liquid Manure to the acre is equal to applying 150 lb. of Sulphate of Ammonia and 4½ cwt. of Kainit.

That such a valuable material should be allowed to run absolutely to waste in the majority of farms is not only a loss to the individual farmer, but to the nation also.

With a view to helping agriculturists who are willing to collect and utilise this important asset, the following suggestions are made for the handling and distribution of Liquid Manure.

It is estimated that the cost of the whole installation would in most cases be recovered within a few years by the saving in artificials which it would effect. Both prices and wages are fluctuating so much at present that no financial statement can well be given.

The arrangements needed are of the simplest description, and provided the few important details of construction, described in this pamphlet, receive careful attention, there should be little difficulty either in installing or using the system.

Leaflet No .382, containing a full illustrated description of the installation, may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries (Publications Branch), 10, Whitehall Place, London, S..W1.

PHYSICAL AND CHEMICAL SURVEY OF THE NATIONAL COAL RESOURCES

The Fuel Research Board have made arrangements for the recognition of the Lancashire and Cheshire Coal Research Association as the local Committee working under the Board for the purpose of dealing with the physical and chemical survey of the coal seams in this area. The Chairman of the Committee is Mr. Robert Burrows, and the Director of Research Mr. F. S. Sinnatt.

It has long been felt that an important aspect of the great problem of the conservation of the national coal resources involves the study and classification of the coal seams which are at present being worked or developed, and also of seams or portions of seams which are being left unworked or are thrown aside above or on its directly practical side must deal primarily with the unsuitability of each particular coal for those purposes for which its individual qualities render it most adequate, e.g., for gas making, coke making, steam raising or for domestic use.

This question of survey has for some years been receiving the anxious consideration of the Fuel Research Board, but the unstable conditions which prevailed in the coal industry during and since the war have necessarily led to the postponement of the work of organisation. It is now, however, considered that the time has arrived when a beginning can wisely be made.

The Fuel Research Board believe that this work can be most effectively carried out with the help of local Committees, in which colliery owners, managers and consumers are associated with the representatives of the Fuel Research Board and the Geological Survey. By this combination not only will local knowledge and experience be made available, but the initiative of those most deeply interested in the practical aspects of this Survey will be secured.

The Survey work will thus from the outset assume a practical character, for the selection of seams for examination will be in the hands of those who are in the best position to estimate the relative importance of the problems awaiting solution. The selected seams will be submitted to physical and chemical examination by the local experts; and, as a result of this examination a further selection will be made of those which appear to justify experiments on a practical scale to test their suitability for particular uses or methods of treatment. This experimental work will be carried out either at H.M. Fuel Research Station, or at other works, as may be found most convenient.

The first Committee is already actively at work in the Lancashire and Cheshire district, where the local Research Association has been recognised by the Fuel Research Board as its representative body for the purpose. It is felt by the Fuel Research Board that the experience gained in the work and organisation of this Committee will be of great value in the establishment of Committees in other districts when the time is ripe for further developments, but they are satisfied that it will be wise to build up this national organisation on the sure foundations of actual experience.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

The Denaturization of Alcohol—Jean Effront.—The author has made an exhaustive study of the composition and quantity of the substances commonly used for the denaturization of alcohol. The commonest is methylene, but in some countries pyridine bases are used in addition, and in Switzerland methyl ethyl ketone is employed. There are great variations in the amounts used, and no method has yet been discovered which excludes the possibility of fraud by regeneration. Nor can the alcohol after treatment be regarded as absolutely undrinkable, and the number of people who have acquired a taste for denaturized alcohol is continually growing. The use of saporin can be recommended for alcohol for domestic use. It has the advantage that very small quantities can be easily detected, and its price is very moderate. Objections may be made to it upon the ground of its toxicity, and it might be advisable to employ an emetic with it. (Moniteur Scientifique, No. 957, December, 1921).

The Presence of Titanium in the soil M. Geilmann, using Hillebrand's method of determination, has investigated the amounts of titanium in many different specimens of ordinary soils. He found that it was present as cathade in all the specimens. Argillaceous soils are richest in it, then come sandy-argillaceous soils; then sandy and calcareous soils, while in pure lime and sand only traces are present. Titanium is to be found in the ashes of all plants, the maximum amount being detected in the ash of the potato (0.269%). It appears to accumulate in the assimilative organs, which confirms the opinion of Traelta Mosca, who believes that titanic anhydride acts as an exidising catalyst in plants. (Journ. für Landwirthschaft, p. 68, 1920.)

Use of Resorcin in Qualitative Mineral Analysis—M. Lavvye.—In an ammoniacal medium resorcin gives characteristic colourations with many metals, and upon this fact can be based a fairly sensitive method of detecting the presence of these metals. The modus operandi is very simple. One cc of a ten per cent. solution of resorcin is added to one cc of a dilute solution of a metallic salt, 2 cc of a ten per cent. ammonia solution are then added, and the mixture is heated for a moment. The colouration attains its maximum after some hours. Zinc is the most sensitive element; it gives an intense blue colouration, and 0.01 mg of zinc give an appreciative reaction, the liquid turning from yellow to yellowish green and finally to blue. The blue colouration, due to cadmium, is rather less intense. Both manganese and nickel give a blue green colouration, while cobalt gives a reddish violet colour which turns to violet with a little bluish tinge. Copper also gives a blue colour. Mercury salts give no special colouration, but resorcin readily dissolves a precipitate of amido-mercuric chloride, and when the solution is evaporated crystals are obtained which resemble those of caffeine. It is noteworthy that when an acid s added to the coloured solutions containing resorcin the colour changes to red, whatever it was before, and whatever the metal present, while when the coloured solutions are evaporated they give a mass of the same colour as the solution. These colour reactions can be used in analytical chemistry to detect very small quantities of metals. (Journal de Pharmacie de Belgique, No. L.II., December, 1921.)

Electrolytic Determination of Antimony —H. Angenot.—The electrolyte usually preferred in order that a satisfactory deposit of antimony may be obtained, is usually a solution of sodium sulphide and potassium cyanide. But it is not possible to obtain a deposit of pure antimony on the caltrode; there is always an excess of weight though the exact nature of the impurity has not been ascertained. Various different electrodes have been suggested, and the author has carried out a series of experiments to find which gives the most satisfactory result, comparing the values obtained by electrolysis with those obtained when the potassium bromate method is used. He finds that it is best to carry out the electrolysis at a temperature of about 65° or 70°, using a cathode of platinum foil, the electrolyte being a solution of sodium sulphide saturated in the cold, and 30 per cent. potassium cyanide. In these conditions the percentage of impurity is always approximately the same, and an accurate result is obtained if the weight of the dried antimony is multiplied by 0.9762 for quantities which exceed 10 cg. (Bull Soc. Chim. Bdg., 1921, p. 268.)

Synthesis of Hydrocyanic Acid by Oxidation of Alcohols, Phenols and Amines in an argento-ammoniacal medium—R. Fosse and A. Hieulle.—If the oxidation of organic substances takes place in presence of ammonia and of a silver or mercury salt hydrocyanic acid can be isolated and estimated. It is also possibly formed as an unstable intermediate product in the respiration of the animal and vegetable cell. Glycerine and formic aldehyde are not the only substances which can yield hydrocyanic acid. Many alcohols, phenols, and amines have the same power, the yields depending upon the nature of the substances and on other factors. Aniline, methylamine, and dimethylamine give large quantities, but when ethylamine is oxidised in the same conditions, only very small amounts of hydrocyanic acid are formed. (Comptes Rendus, CLXXIV., Jan. 3, 1922.)

FUEL IN SCIENCE AND PRACTICE.

With the next issue of the *Colliery Guardian* will appear a supplement—to be repeated with the fourth issue in each month —which will constitute a monthly record of British and foreign research regarding the preparation and use of fuel.

The first number will contain a "foreword" by Sir George Beilby, F.R.S., Director of the Fuel Research Board, as an earnest of his interest in this attempt to place before the users of fuel, in its various forms, a periodical account of contemporary research.

The first number, in addition, will include articles by S. R. Illingworth, of the South Wales School of Mines, on "Coal and its Carbonisation"; by Dr. R. Lessing on "The Study of Mineral Matter in Coal"; by F. S. Sinnatt (of the Lancashire Coal Owners' Coal Research Association), and L. Slater, on "Producer Gas from Pulverised Fuel"; and by Dr. R. V. Wheeler (Prof. of Fuel Technology in the University of Sheffield) and R. Wigginton on "Resins in Bituminous Coal." A "Review of Current Literature" will complete the supplement. The supplement will be circulated gratis with the journal or mailed separately to subscribers where desired, and will be edited jointly by Professor Wheeler and Dr. J. V. Elsden, joint editor of the *Colliery Guardian.*

PROCEEDINGS OF SOCIETIES.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society held at the Imperial College, on Thursday, 12th January, Mr. R. S. Whipple, President, in the chair, the following papers were read and discussed:—

1. "The Manufacture of Optical Glass," by Dr. C. J. Peddle.

The history of the manufacture of optical glass can be divided into four epochs, Guinand's discovery of the stirring process in 1796, the work of Abbe and Schott about 1882, and the development in England during the Great War being the outstanding features in this history. The method of manufacture, which was described in detail, is practically the same at the present time as in Guinand's day, any improvement being one of degree rather than of kind.

For successful production of the various types the effects of composition upon density, refractive index, melting properties, durability, freedom from colour, and devitrification tendencies have to be studied upon a small scale, and the results translated into terms suitable for works practice. Results were given of systematic investigations to determine the relation between composition and these various properties.

2. "The Barr & Stroud 100ft. Self-contained Base Rangefinder." By Dr. James W. French.

Depression, two-position, and more recently self-contained types of rangefinder have been employed for coast defence purposes. The first two types are subject to several disadvantages which have led to the introduction of the 100ft. base self-contained instrument. The rangefinder has a new type of triple field. It is carried upon a mounting comprising two trucks running upon a roller path of 50 feet diameter, the trucks being connected by a rigid horizontal framework. Upon the trucks are carried contilevers from the ends of which are suspended cradles having special bearings within which the rangefinder rests. Training is done by power or by hand. During extensive tests the uncertainty of observation at a range of 31,000 metres did not exceed 20 metres.

3. "The Optical Three Apertures Problem." By T. Smith, F.Inst.P.

In such an instrument as a submarine

periscope, where broad beams of light have to be transmitted down a long tube from a wide field, the relation between the length and diameter of the tube and the number of lenses was considered. Various types of construction were indicated, together with the relative advantages offered by them.

"PRESENT PROBLEMS OF THE DYE INDUSTRY."

The Presidential address to the University of Birmingham Chemical Society was delivered on January 23rd, on the above topic, by Professor G. T. Morgan, F.R.S., who, in the course of his remarks, referred to the establishment on a modest scale of the dye industry in England and France by Perkin, Verguin, Nicholson, Gerard and other pioneers. The German colour industry was founded somewhat later, but owing to the closer co-operation of science and industry expansion occurred more rapidly in Germany, in Switzerland, with the result that by 1914 the supremacy of these centres of industrial chemistry was unchallenged.

The industrialisation of indigo was cited as a classical example of the self-sacrificing team work by the aid of what the great German colour firms secured the trade in Alizarin dyes, direct cotton colours, sulphur dyes, and the entirely new vat dyes, discovered at the beginning of the 20th century.

The war showed that the German dye factories were potential arsenals for the mass production of high explosives and of poison gases, inasmuch as the latter materials were almost entirely manufactured by the colour works.

After surveying recent developments in this country, the lecturer emphasised the educational importance of the dyestuffs industry, which in its evolution abroad proved a potent factor in the development of the German chemical industry. The commercialisation of atmospheric nitrogen, the highly profitable trade in synthetic drugs, the production of photographic materials, certain modern metallurgical enterprises, and many other high grade industries have arisen as offshoots in the great colour works. He drew the inference that only by a similar close attention to the synthetic chemical industries could the British Empire be rendered self-reliant in regard to the exploitation of all its chemical resources.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922.
FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—"The Teeth of the Nation."

February 17.—Dr. S. M. Watson, MSc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—"History of the Mammalian Ear."

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

January 28.—Dr. C. Macpherson—"The Evolution of Organ Music."

January 31.—Prof. H. H. Turner—"Variable Stars."

February 2. — Sir Napier Shaw—"Droughts and Floods."

Royal Institution.—Saturday, Feb. 4: Prof. E. de Selincourt, Humorists of the Seventeenth Century, 3; Monday, Feb. 6: General Meeting, 5; Tuesday, Feb. 7: Prof. H. H. Turner, Variable Stars, 3; Thursday, Feb. 9: Sir Napier Shaw, Droughts and Floods, 3; Friday Evening, Feb. 10: Prof. W. D. Hallihurton, The Teeth of the Nation, 9.

THE GEOLOGICAL SOCIETY.

The Annual General Meeting of the Society will be held at the apartments of the Society in Burlington House, on Friday, February 17th, at 3 p.m.

After the official business, the President's address will be delivered.

The anniversary of the Society will be celebrated by a dinner at the Criterion Restaurant in the evening.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks and Designs can be obtained gratuitously.

Latest Patent Applications.

34551—Barber, T. W.—Recovery of colloidal matter from liquids. Dec. 22.

34281—Clerc, C.—Manufacture of magnesia from dolomite. Dec. 20.

34279—Thermal Industrial and Chemical Research Co.—Distillation of tar. Dec. 20.

Specifications Published this Week.

172,337 Douglas, R. P.—Apparatus for use in the manufacture of sulphate of ammonia.

159,156—Kaltenbach, M. H.—Process for the manufacture of sulphuric acid.

149,915—Brutkus, M.—Apparatus for chemical production and research.

154,562—Soc D, Rudes Chimiques Pour l'Industrie.—Process for the manufacture of a mixed manure containing a variable amount of nitrogen and phosphates.

172,390—Brougham, F. J.—Process of and apparatus for separating finely-divided minerals from their ores by froth flotation.

172,411—Erikson, H. F.—Process and furnace for the reduction of metallic oxides.

Abstracts Published this Week.

Sulphuric Acid.—Patent No. 170,880.—A new method of obtaining sulphuric acid has been invented by Mr. A. Matheson, of 146, Bishopsgate, London.

The acid is obtained by calcining alunite and passing the evolved gases over the cooler parts of the alunite which by reason of the catalytic effect of the iron oxide it contains effects and recombination of the sulphur dioxide and oxygen. The calcination may be performed in any closed type of furnace in which the dilution of the gases with air or furnace gases is avoided, but preferably one is used in which the crushed material fed in at the top is mechanically passed down a series of hearths the bottom one of which is heated by external means to a temperature of 700-900°C. The cooled gases pass on to a condenser, and sufficient water in the form of steam or a spray to form sulphuric acid is injected either into the furnace or into the condenser.

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3226.

FEDERATION OF BRITISH INDUSTRIES.

The attached letter, dated 2nd February, 1922, has been sent to the Postmaster-General:—

Sir,—The Federation of British Industries have for some time had under consideration the grave effects upon the industrial community of the present heavy charges for postal, telegraph and telephone facilities.

They fully realised the difficulties which confronted the Post Office as a consequence of the war, and have hitherto been reluctant to press any general criticism, confining themselves to bringing to your notice, or to that of your officials, specific difficulties and causes of hardship or inconvenience as they arose.

Sufficient time has, however, now elapsed since the Armistice to permit of any necessary reorganisation of the postal and other services under the charge of your Department. A considerable reduction in the cost of materials has taken place, and the general fall in the cost of labour which has accompanied the fall in the cost of living should not have been without its effect on the expenses of a Department which is a large employer of labour.

Under these circumstances, the Federation feel that it is not inopportune to urge on you the importance of reducing charges which are a severe handicap to the revival of trade, and they were glad to notice a statement by you in the Press to the effect that the Post Office should not be regarded as a revenue-earning Department, but that any surplus which might occur in the Post Office balance sheet would be reflected in a reduction of the charges to the public.

They notice with regret your statement in the *Observer* of January 22nd, that you do not anticipate a surplus in the Post Office accounts as a result of the present year's working, but trust that you will be able, in framing your estimates, to anticipate such substantial economies in the forthcoming year as to permit at least the immediate reduction of the more onerous charges, and a further progressive reduction throughout the year in all the charges.

The Federation would urge that particular reduction of the postcard and printed paper rates, which not only most seriously affect the printing industry as producers, but also affect every other industry as consumers. In making this request, the Federation desire to support most emphatically the representations which have already been addressed to you on this subject on behalf of the printing trade. If, as they understand, the inland printed paper rate is not at present remunerative on account of the elaborate sorting which it entails, they consider that serious attention should be devoted without delay to the simplification of the regulations governing the postage of printed matter, in order that the expense of sorting may be reduced.

In addition to the reduction of rates, the Federation would desire also to urge upon you that the collection of letters on Sunday might be resumed. It is an undoubted fact that the abandonment of the Sunday collection seriously delays the work of many businesses on the Monday, and consequently tends to dislocate the whole business arrangements of the earlier part of the week. This difficulty is rendered the more serious, as the Federation are assured that in many parts of the country there are serious delays in Saturday deliveries.

The Federation have refrained from making any suggestions with regard to the Telephone service in this letter, as they realise that you are still awaiting the Report of the Select Committee of the House of Commons, which has been considering the question. They are confident that the Committee's recommendations will enable you to make substantial economies in the working of the service, and they trust that these economies will be reflected in reduced rates.

In conclusion, the Federation wish to emphasise the pressing need to Industry of sympathetic consideration of these suggestions in the present difficult times, and to express the hope that you will be able to announce at an early date that you are proposing to offer early relief from the existing high rates charged by the Post Office for its services.

I am, Sir,
Your obedient servant,
R. T. Nugent,
Director.

The Rt. Hon. F. G. Kellaway, M.P.,
Post Office,
St. Martins le Grand,

Contribution from the Department of Chemistry, Cornell University.

GERMANIUM III. GERMANIUM TETRABROMIDE AND GERMANIUM TETRACHLORIDE.[1]

By L. M. Dennis and F. E. Hance.

A.—Germanium Tetrabromide.

Winkler[1] prepared what he assumed to be germanium tetrabromide by heating germanium in vapour of bromine, and also by heating a mixture of pulverised germanium and mercuric bromide. He stated the product to be a mobile, fuming liquid which solidified at 0°C. or sligbtly below that temperature to a white crystalline mass. He did not analyse or make further study of the compound because of lack of material.

The present investigation describes the preparation and further study of this substance.

Material.

Germanium was prepared in finely-divided form by reducing[1] germanium dioxide in a current of hydrogen at temperatures between 550°C. and 600°C. Toward the end of the reduction the temperature was raised to 900°C.

Bromine was purified by first digesting it with calcium bromide and zinc oxide,[1] then distilling off the bromine, converting the middle fraction to hydrobromic acid by treating it with sulphur dioxide in the presence of water, distilling off the hydrobromic acid, and liberating the bromine from this by means of pure manganese dioxide. This bromine was re-distilled, was next dried over phosphorus pentoxide, and was then again distilled. The middle fraction was used.

Preparation of Germanium Tetrabromide.

Powdered germanium was placed in alundum boats which were inserted into a tube of Jena glass lying in an electric combustion furnace. A thermometer was laid in the combustion tube alongside the boats. To the front end of this tube was attached an inverted T tube. The upright arm of the T tube was sealed to a separatory funnel containing bromine. The further end of the T tube was joined to a chain of apparatus supplying purified nitrogen. The exit end of the combustion tube was brought well within a long adapter which in turn was fused to the inlet tube of the first of two small, all-glass distilling bulbs.[1] The side arm of the second bulb was connected with a U-tube containing calcium bromide, and this to a water suction-pump and manometer.

In beginning the procedure, nitrogen was started flowing slowly through the apparatus. Slight diminished pressure was maintained throughout the run by suitable adjustment of the suction pump. When the whole apparatus was filled with nitrogen, bromine was slowly admitted into the T tube. A small alcohol lamp placed beneath this tube hastened the volatilisation of the bromine. A freezing mixture of ice and salt was brought up around the bulb that served as the first receiver.

Reaction between the bromine and germanium began at once in the unheated tube (26°), small, colourless globules of oily liquid appearing on the inner surface of the tube. Combination of the two elements apparently ceased after a short time, and vapour of bromine passed over into the receiver. The temperature of the tube was then slowly raised. At 180°C. slow union again was discernible. At 220°C. germanium bromide was rapidly produced, and it was found that bromine could not be admitted at the rate of 20 drops per minute without any appreciable amount of it escaping combination with the germanium. The temperature was maintained at 220°C. until the interaction apparently had ceased and free bromine appeared in the receiver. During the experiment, an oily liquid had steadily passed over, and had collected entirely in the first of the receiving bulbs. The admission of bromine was now stopped and the apparatus was allowed to cool in the current of nitrogen. During this interval the distillate in the cooled receiver solidified to a yellowish white solid.

There remained in the alundum boats a greyish white residue which proved to be chiefly germanium dioxide. The reasons for its occurrence here will be discussed in a later article.

The flask containing the distillate was disconnected from the chain, a U-tube filled with calcium bromide was attached to the side-arm, and the neck of the flask was tightly stoppered. The contents was

[1] The investigation upon which this article is based was supported by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University.

[1] J. prakt. Chem. 144 (New Series 36) 193, 1887.

[1] Further details concerning this reaction will be given in a later article.

[1] Richards and Merigold, Am. Acad. Arts and Sci., 37, 387 (1901-2).

[1] See Dennis and Bridgman, this Journal, 40, 1543, Fig. 5, 1918.

warmed until it melted, and about 2 cc. of mercury was then introduced. Agitation of the flask soon removed the free bromine, and the supernatant liquid became clear and colourless. Later analysis showed that the product is germanium tetrabromide. Before making the analysis to establish its identity, the liquid was purified by fractional distillation and its boiling point was determined.

The germanium tetrabromide was siphoned off from the mercury into a dry distilling flask, the substance being carefully protected from moisture during the transfer. It was then twice distilled, but a sample of the second distillate showed on spectroscopic examination the presence of a slight amount of mercury. For this reason a second preparation of the germanium tetrabromide was prepared, and from this the free bromine was removed by repeated fractional distillation instead of by the use of mercury. A large middle fraction that passed over at about 183°C. was then used for the determination of the boiling point, and 71 readings, taken at one minute intervals, gave a constant boiling point of 183.0°C., the total weight of the germanium tetrabromide that distilled over at this temperature being 97.47 grams. The corrected boiling point was then calculated according to the formulæ given by Young.[1] There is no formula that is generally applicable to the accurate correction of the observed boiling point to that under standard pressure. Young states that quite precise results are, however, obtained by the use of the formula $\theta = K(760 - P)(273 + t)$. Provided the value of the constant K is determined experimentally, θ is the correction in Centigrade degrees to be added to the observed boiling point t, and P is the barometric pressure corrected to 0°C. Young gives the value of K for several substances, among which are silicon tetrachloride and tin tetrachloride. He further states that the value of the constant is not altered by replacing one halogen by another. Inasmuch as germanium lies between silicon and tin in the fourth group of the periodic table, the value of K for germanium tetrachloride and germanium tetrabromide may be assumed to lie midway between the value for silicon tetrachloride, 0.000126, and that for tin tetrachloride, 0.000121. The boiling point of germanium tetrabromide thus corrected is 185.9°C.

Analysis of Germanium Tetrabromide.

Portions of about two grams each of the substance were introduced into small glass capsules of known weight and the capsules were then sealed and weighed again. A capsule was broken under absolute alcohol and the solution was diluted to 250 cc. with absolute alcohol. Two portions of this solution were used for the analyses. The bromine was determined by precipitation as silver bromide. The filtrate was freed from silver by the addition of hydrobromic acid in very slight excess. The silver bromide was filtered off, concentrated hydrochloric acid was added to the filtrate until the acidity was 6N and the germanium was then precipitated by hydrogen sulphide. The germanium sulphide was washed with alcohol, was then oxidised with nitric acid, was ignited at red heat to constant weight, and was weighed as germanium dioxide.

In calculating the results of the analyses, 72.5 was used as the atomic weight of germanium.

Wt. of $GeBr_4$.	Weight of Ge Found.	Calc.	Weight of Br. Found.	Calc.
0.2158	0.0403	0.0398	0.1753	0.1759
0.2158	0.0399	0.0398	0.1756	0.1759

The results of the analyses, while not in close accord with the theoretical, suffice to establish the identity of the substance as germanium tetrabromide.

The Melting Point of Germanium Tetrabromide.

About ninety grams of germanium tetrabromide of constant boiling point was brought into a large test tube and its melting point was determined with the aid of an Anschütz thermometer that had been calibrated by the Bureau of Standards. The observed melting point was 26°C. The corrected melting point was 26°C.

The Crystal Form of Germanium Tetrabromide.

A crystallographic examination of the substance was kindly made for us by Professor A. C. Gill, of the Department of Mineralogy. Inasmuch as the substance could not be exposed to the air during observation under the microscope, a sample of about one cc. was sealed in a thin-walled glass tube and was cooled therein until it crystallised. The crystals were found to be brilliant, white, flattened octahedrons, which under polarised light proved to be isotropic, which indicates that they belong to the regular system.

The Index of Refraction of Germanium Tetrabromide.

An approximate determination of the index of refraction was first made, using a

microscope, Abbé condenser, and graduated screen. The germanium tetrabromide was placed in a small brass cell that was mounted on a cover glass. The cell was first calibrated with water, oil of cedar, and oil of cassia. The approximate value for the refractive index thus obtained was 1.61.

More accurate determinations of the index of refraction were then made with an Abbé refractometer. The super-cooling exhibited by germanium tetrahromide made it possible to make a series of readings at temperatures below the melting-point of the substance.

Temperature.	Index of Refraction.
20.75°C.	1.6296
21.10°C.	1.6292
22.20°C.	1.6283
24.00°C.	1.6274
24.50°C.	1.6272
25.50°C.	1.6268

Index of Refraction of Germanium Tetrabromide at 25°C. = 1.6269.

Fulcher.

The Specific Gravity of Germanium Tetrabromide.

A pycnometer of 10 cc. capacity was dried over phosphorus pentoxide, and was then quickly filled with germanium tetrabromide. The measurements were made at 29° to keep the substance in liquid state. At this temperature, the specific gravity of $GeBr_4$ 29°C.

= 3.1315.

29

The Electrical Conductivity of Germanium Tetrabromide.

An alternating current, 1,000 cycles per second, 6 volts was used. Resistance was measured by a Wheatstone briage with telephone attachment. A conductivity cell of 18cc. capacity, and 90mm. between platinum electrodes, was filled with germanium tetrabromide and was at once sealed to prevent contact with the moisture of the air. The cell was placed in a bath that was maintained at a constant temperature of 30°C. A resistance totalling 300,000 ohms was found to be insufficient to balance the resistance of the cell. This shows that the Specific Conductivity of germanium tetrabromide is less than 0.000078 reciprocal ohm.

Chemical Properties of Germanium Tetrabromide.

In the liquid form germanium tetrabromide is a colourless, mobile liquid which fumes when brought in contact with the air. It shows to a marked degree the property of super-cooling, and it was round that the liquid when not agitated could be chilled to a temperature of —18°C. before it solidified. The substance crystallises in minute white octahedrons. This crystalline mass gradually changes on standing into a clear, hard, transparent, glass-like material with fractures running through it like the fissures in a lump of cracked glass.

When a few drops of water were added to about 1cc. of liquid germanium tetrabromide, hydrolysis at once took place with the evolution of heat. A layer of hydrated germanium dioxide formed at the surface, and if the tube was not agitated, two liquid layers appeared below this solid crust. The lower layer consisted of unchanged germanium tetrabromide and the upper layer of a suspension of germanium hydroxide.

When a drop of germanium tetrabromide was allowed to fall into water, a small white ring of hydrated germanium dioxide was formed and further deposit of the white hydroxide around the circumference of this ring rapidly built up.

In one experiment 25 grams of germanium tetrabromide was poured into 50cc. of water. The tetrabromide sank to the bottom of the tube, and at the surface of contact between the two liquid layers there was rapidly formed a heavy film of germanium hydroxide. Above this film there gradually appeared a fine suspension of this substance. The layer of germanium hydroxide protected the tetrabromide below it from further hydrolysis for more than 24 hours, the hydroxide forming a tough impervious stratum. The water above this layer of germanium hydroxide gradually cleared up and this clear solution gave a decided acid reaction to litmus. When germanium tetrabromide is dropped into water, there is noted a slight but distinct crackling sound. It is scarcely audible, and it would probably have escaped attention were it not for the fact that a similar phenomenon had already been noticed when germanium tetrachloride and water are brought together.

When a few drops of germanium tetrabromide were allowed to fall into 2cc. of concentrated sulphuric acid, the substance sank to the bottom of the tube and no reaction nor visible change took place during the several days that the tube was allowed to stand at room temperature. This behaviour is similar to that of the tetrachlorides of tin and lead, elements which lie below germanium in Group 4 of the Periodic Table.[1]

When germanium tetrabromide was introduced into a aqueous solution of potassium hydroxide (1:4), reaction took place at once with the evolution of heat. Germanium hydroxide first separated and then quickly dissolved in the alkali. When carbon dioxide was passed through this solution of potassium germanate, a heavy white precipitate resulted.

When germanium tetrabromide was dropped into concentrated nitric acid, it fell to the bottom of the tube and gradually took on a deep orange colour. The nitric acid above the tetrabromide became yellow and turbid and was rapidly reduced. The layer of germanium tetrabromide soon took on a dark brown colour and a disk of white germanium oxide formed between the two liquid layers. After about fifteen minutes the colour of the tetrabromide changed to black and the reaction between it and the nitric acid went on slowly with copious evolution of nitric oxide. After the reaction had ceased, water was added to the contents of the tube, whereupon there formed a precipitate that appeared to consist of white powder, a yellow substance, and the black amorphous precipitate previously mentioned. The supernatant liquid was clear and of a pale yellow colour. After standing for twenty-four hours, the precipitate in the bottom of the tube became entirely white.

With dry ammonia gas, germanium tetrabromide formed a white solid compound which is probably analogous to the corresponding compounds of ammonia with the tetrabromides of silicon and tin. This substance is now being subjected to further study.

Germanium tetrabromide was found to be soluble in absolute alcohol, carbon tetrachloride, benzene, and ether without decomposition. It dissolves in acetone, but slow decomposition takes place with the liberation of bromine.

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[1] [illegible] 25, 1434 (1903).

SOCIETY OF GLASS TECHNOLOGY.

A meeting of the Society of Glass Technology was held in the Applied Science Department, The University, Sheffield, on January 18th, 1922, the President, Dr. M. W. Travers, F.R.S., in the chair.

After an announcement by the President as to the forthcoming visit to this country of the American Ceramic Society, probably in September, a general discussion took place on the subject of "The Durability of Glass." The first paper presented was "An Examination and Extension of Zulkowski's Theory of the Relation between the Composition and Durability of Glass," by W. L. Baillie, A.I.C. In the absence of Mr. Baillie an abstract of the paper was given by Prof. W. E. S. Turner, who said that Zulkowski's theory was based largely on direct chemical evidence. It assumed that, in the founding of glass, the essential reactions involved were, primarily, the formation of simple silicates of the alkalies and alkaline earths, and that subsequently these bodies combined to form double silicates which were regarded as the characteristic constituents of all serviceablo glassware. This second reaction was the slower, and it would not proceed to completion unless the melt was maintained at a sufficiently high temperature for an adequate period. In all these reactions the bases were regarded as competing equally for the acids, and it was further assumed that all the materials of the batch entered completel into reaction. If one type of base, alkali or lime, be molecularly in excess, simple silicates would remain in the glass, and would persist irrespective of fining. These simple silicates were regarded as the prime cause of instability.

If a glass had the molecular composition:

SiO_2	a per cent	(a+b) molecules
R_2O_3	b per cent	per cent o
RO	c per cent	acidic oxides
R_2O	d per cent	

when a sum of the bases was greater than three times the molecular proportion of R_2O_3 oxides, it was proposed to regard the R_2O_3 oxides as combining to form boro or alumino silicates, which may be formulated as 3b MO, bR_2O_3, n SiO_2. There was now a residue of bases amounting to (c+d−3b) molecules, and of SiO_2 amounting to (a−n) molecules. On the [illegible] the bases were propor-

tionally distributed among the silicates and complex silicates, the individual residues of RO and R2O bases would be proportional to the amounts originall ypresent ,and so

Residue of RO bases = c (c+d - 3b) molecules.
(c+d)

Residue of RO bases = d (c+d - 3b) molecules.
(c+d)

Following Zulkowski's original theory, the bases combined as simple silicates would amount to (c - d) (c+d - 3b) molecules.
(c+d)

The difference between Zulkowski's original theory and that now proposed lay essentially in the different quantities deduced for the number of molecules of simple silicates. By the former theory the quantity (c - d) was obtained, to which the term "basic excess" was applied. The theory proposed gave the more complete function

(c - d) (c+d) - 3b)
(c+d)

for which the term "reactivity coefficient" was suggested.

Zulkowski's original theory failed to explain the durability of glasses containing any considerable proportion of Al_2O_3 and B_2O_3l. The agreement between calculated and observed reactivities, by the proposed theory, was generally as good as in the case of the simpler types. In general, glasses of satisfactory resistance were found to have reactivity co-efficients of under three units, and the best commonly had values of two units or less. Negative values were generally associated with the most stable glasses, though very large negative values were probably undesirable. Glasses whose co-efficients exceeded five units were unstable for chemical ware.

The second paper presented was entitled, "A Critical Note on the Methods of Determining the Durability of Glass," by Prof. W. E. S. Turner, D.Sc. Prof. Turner said that there were a number of methods possible, but he proposed to discuss only a few of those in fairly general use. Dealing first with the expression of the results obtained, the method of stating the loss in weight due to the attack of reagents, was not a reliable check. It was better, where possible, to determine the amount of alkali liberated. With regard to the form of the test pieces, flasks gave different results from beakers, especially where the temperature was such that volatile reagents or vapours caused action. Also, as flasks differed in shape the area of the liquid in contact differed for definite weight or volume of the reagent; while pieces immersed appeared to give results different from those obtained where one surface only was in contact with the reagent. Four modes of test were indicated:—(a) The Static method—with flasks and beakers, (b) The use of slabs and discs immersed in the reagent, (c) The Autovalve test, (d) For convenience and rapidity a good method was that of using glass, ground up to mesh 20 to 30, though Dr. Peddle advocated the 160 mesh.

The whole subject, however, was one requiring careful investigation, and in the speaker's opinion it was one which could be most appropriately dealt with by the Glass Standards Committee of the Society.

A third paper, "The Effect of Magnesia on the Durability of Glass," by Miss C. M. M. Muirhead, B.Sc., and Prof. W. E. S. Turner, was presented by the latter. In this paper a comparison was made of the results obtained from the action of certain reagents on lime glasses, and on magnesia glasses. Resistance to attack by water was determined from tests made on glass crushed to mesh 20-30, and boiled for 1 hour. The amount of sodium oxide set free was greater in the case of the lime glasses than in the case of the magnesia glasses. The results of tests on boiling discs in hydrochloric acid for 6 hours showed that a glass containing small amounts of magnesia was much more resistant than the corresponding lime glass. The effect of increasing the amount of magnesia was not so marked as the effect of increasing the lime. Magnesia glasses were found to be less resistant than lime glasses to attack by both sodium carbonate and caustic soda, after boiling for three hours. It was also found that the loss in weight for sodium carbonate was greater than the loss in weight with caustic soda.

Taking the whole subject of corrodibility in a general way, there was not much difference between the lime and the magnesia glasses. One set held the advantage towards one particular reagent, and the other set held the advantage towards another reagent.

The papers elicited a lively discussion, in which there took part the President, Messrs. F. W. Adams, A. Bunce, F. G. Clarke, J. R. Clarke, E. A. Hailwood and W. J. Rees.

The President intimated that the next meeting would be held in Manchester on February 15th, when part of the time would be devoted to questions.

NOTES ON BOOKS.

Synthetic Tannins, their synthesis, industrial production, and application, by GEORG GRASSER, DR. PHIL. ING., translated by F. G. ENNA; CROSBY, LOCKWOOD & SONS, 7, Stationers' Hall Court, Ludgate Hill. Price 12/- net.

The author has held the appointment of technical consultant to the Austrian Leather & Hides Commission, and in this capacity was called upon to act as general adviser to the trade. The importance of synthetic tannins and their use will help to make the industry independent of foreign productions.

In the translator's preface it is stated that the number of substances patented by German chemists for the production of synthetic tannin materials was almost staggering, and the translator has done a public service in bringing the work of Dr. Grasser to the hands of the British leather industry.

The book opens with an introduction to the classification of tannins and the chemistry of tannin materials. A good chapter is devoted to the production and application of tannins and the chemical examination of leathers that have been tanned by various processes. The book is purely technical in its character, and will be found indispensable to the chemists of the leather industry. There is an index of authors' names as well as of subjects.

Critical Microscopy How to get the best out of a Microscope, by ALFRED G. COLES, M.D., with illustrations. London, J. A. CHURCHILL. Price 7/6 net.

This is a thoroughly practical book by an Englishman, upon the English microscope. The author states that the English-made microscope of to-day is an instrument of precision, and that some British models have never been equalled by any of the best Continental manufacture.

The first portion of the book deals with a description of the microscope, its objectives, condensers, eyepieces and other details. This is followed by a very valuable section on the manipulation of the microscope and its accessories, and full details are given of the author's method of making stained preparations, micrometry and photo-micrography. Very complete photographic illustrations are given of the arrangements of in the Faraday Society, but in the Society for Glass Technology, and other similar institutions, that the microscope can be made of the greatest value in almost any industry, and a practical work of this description will be found of the very greatest use to anybody who proposes to use this means of investigation.

THORIUM IN MONAZITE SAND.

The *Journal* of the *American Chemical Society*, No. 9, Vol. 43, for September, 1921, gives a detailed account of a novel method, by Homer H. Helmick, for the determination of Thorium in monazite sand by means of its emanation. Full descriptions and illustrations are given of the working details, and the results show that analyses by this means will give results that agree very closely with those obtained by gravimetric methods, and requires very much less time for the determination.

The November issue of the same journal contains an account of a scheme for separating Columbium and Tantalum by means of selenium oxychloride, by Henry Baldwin Merrill. The paper in question is a portion of a thesis presented to the university of Wisconsin. The previous methods for separation are reviewed, and full details are given of the new reaction. Numerical particulars are recorded of results obtained by the application of the method to the separation of synthetic mixtures of Tantalum and Columbium pentoxides, which show great accuracy. The paper is followed by another upon the separation of Molybdenum and Tungsten, by the same reagent.

FUEL IN SCIENCE AND PRACTICE.

"Fuel in science and practice" is the title of a new journal devoted to the science and economic use of fuels, being the record of the Coal Research Club.

The journal opens with a foreword by Sir George Beilby, F.R.S. Sir George gives the reason for the appearance of the publication and emphasises its importance.

The following important articles are given in the issue: The first by Messrs. F. S. Sinnatt & L. Slater, on Producer Gas from pulverised coal. Coal and its carbonisation, by Sir Roy Illingworth. The Study of Mineral Matter in Coal, by Dr. R. Lessing. Resins in Bituminous Coal, by R. V. Wheeler and R. Wigginton. The articles are all of thoroughly practical value in connexion with fuel science. Then follows a review of

The journal is to be published on the fourth Friday in each month. Annual subscription 10/6, post free. Communications to be addressed to the Manager, 30 & 31, Furnivall Street Holborn, E.C.4.

A French-English Dictionary for Chemists, by AUSTIN M. PATTERSON, Ph.D., formerly editor of *Chemical Abstracts*. New York, JOHN WYLIE & SONS. London, CHAPMAN & HALL, LTD.

The author's German-English Dictionary for Chemists has proved of such value that it was decided to republish the French-English Dictionary on the same lines. The design of the work is to meet the need of the practical chemist, and it is more than a mere collection of words with their English equivalents. A large number of phrases have been introduced. At the commencement of the book there will be found a number of typical regular verbs, which will save reference to a grammar. A general vocabulary has been included with the technical words, and no pains have been spared to make the work of real value to chemists and physicists generally. It is well printed and in convenient size for the desk, and the price of 18/- is very reasonable.

Biological Chemistry, by H. E. ROAF, M.D., D.Sc., M.R.C.S., L.R.C.P., Professor of Physiology at London Hospital Medical College, University of London. Pp. xvi.+216, fully illustrated. London, METHUEN & Co., LTD. Price 10/6 net.

The object of this work is to give the reader a general survey of the various chemical processes which take place in living organisms.

The book is divided into three sections. The first section is devoted to introducing the reader to the subjects of organic and physical chemistry, so that the problems dealt with subsequently can be duly appreciated. The author has been very successful in his treatment of the latter subject, but the chapter on organic chemistry is not so satisfactory as the treatment of the elementary conceptions of this subject will not meet the requirements of those unfamiliar with this branch of chemistry, it seems probable that the author would have been better advised to have assumed that his reader possessed an elementary knowledge of organic chemistry. Sections two and three deal with the problems associated with anabolism and catabolism respectively. The in a very interesting manner, but as usual the catabolic changes receive more attention than those of an anabolic nature. On one page the following statement occurs—' all living cells can synthesise, but not all cells can store radiant energy. . .' Surely it is usual to regard living cells as transformers rather than as synthesisers of energy!

The book contains certain features which deserve special mention. At the end of each chapter a list of the works which deal with the subject matter of the chapter in greater detail is given, and the references to the literature are given at the foot of each page, so that the original work can be consulted when necessary, but the inclusion of the usual list of "Literature Abbreviations" has been overlooked.

Unfortunately, the book contains several printer's errors, but a matter of more serious consequence is the fact that the numerous excellent diagrams and tables have not been satisfactorily incorporated into the text.

Nevertheless, despite the shortcomings referred to above, the book can be recommended as a good introduction to this fascinating subject.

F. L. S.

A Study of Arc-Cathode Spectra, *Astrophysical Journal*, 54, 65-75, July, 1921. The University of Chicago Press, Chicago, Ill. By Arthur St. C. Dunstan and Benjamin A. Wooten.

ABSTRACT.

Arc spectra; relative intensity of metallic lines at anode and cathode.—A series of experiments were performed to *test various suggested explanations* for the fact, amply verified by the authors, that metallic lines are always stronger at the cathode when the metal is introduced symmetrically. A horizontal arc inclosed in a furnace was fed wth metallic vapour (Sr, Ba, Li, Cu or Pb) supplied by an alternating current arc 5 cm below. Water-cooling either electrode had no effect, and attempts to obtain separation of the vapours electrolytically or by electrostatic action failed. The spectrum of a 60-cycle alternating current arc taken through a rotating sector synchronized to transmit light during only half of each cycle, was the sam eas that of a direct current arc. This proves that the phenomenon is fully developed in 1/120 second, and makes it unlikely that it is due to the transference of

either thermally or electrically. When small pellets of metallic salt were dropped through the arc, the spectrum lines were fish-shaped with the heads towards the cathode. The evidence as a whole indicates that the light is due chiefly to bombardment of the metallic vapour by electrons from the cathode.

Variations with atomic weight. — In general the ratio of cathode to anode intensity was found to decrease as the atomic weight increased.—GORDON S. FULCHER.

BOOKS RECEIVED.

"Organic Chemistry or Chemistry of the Carbon Compounds," Victor von Richter. *Pages: xvi.-760.* George *Routledge & Sons, Ltd.*, Broadway House, 67-74, *Carter Lane*, Ludgate Hill, London, E.C 4, 1922. Price: 35/- net.

"Confectioners' Raw Materials,' James Grant, J.P., M.Sc.Tech., F.I.C., F.C.S. Pages: V.-173. Edward Arnold & Co., 41 & 43, Maddox Street, London, W., 1921. Price: 8/6 net.

"The Measurement of Steady and Fluctuating Temperatures," R Royds, M.Sc., A.M.I., Mech.E. Pages: XI.-162. Constable & Company, Ltd., 10, Orange Street, Leicester Square, W.C., 1921. Price: 16/-.

PREPARATION OF TUNGSTEN.

The *Journal of the Australasian Institute of Mining and Metallurgy*, No. 43, for September, 1921, contains a valuable paper upon the preparation of Tungsten and the assays of low grade ores, by Herbert Lavers, A.S.A.S.M. The paper is a very valuable contribution to the history of the chemistry of Tungsten, and is intentionally bound in such a manner that it can be easily detached from the journal if desired.

ROYAL INSTITUTION.

Saturday, Feb. 11., Prof. E. de Selincourt: Humorists of the Seventeenth Century, 3. Tuesday, Feb. 14, Prof. H. H. Turner: Variable Stars, 3. Thursday, Feb. 16, Prof. A. G. Perkin: Dyeing, Ancient and Modern, 3. Friday Evening, Feb. 17, Dr. S. M. Watson: History of the Mammalian Ear, 9.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Detection of Small Quantities of Pyridine. —(A. Goris and A. Larsonneau).—In presence of cyanogen bromide pyridine combines with aniline, giving the bromide of anilido-phenyldihydro-pyridinium, which is a red crystalline substance, fusing at 162°. If 5-10 cq of recently prepared cyanogen bromide are added to a mixture of a drop of pyridine, a drop o faniline and 1 or 2 drops of water, an intense red colouration appears at once, and a precipitate of crystalline needles is formed. The reaction is very sensitive, and the colouration is easily seen, even when the dilution is $\frac{1}{400,000}$; in this case, however, the liquid is first yellow, turning orange after about half-an-hour, while in from 24 to 48 hours drops of a red oil separate. No reaction is obtained with pyrotic derivatives such as a-methyl-pyrolidine, and hence the production of this colouration may be used to detect pyridine in presence of these bases. (Bul. Sc. Pharmacol, 1921, p. 497.)

Synthesis of Camphor.—(E. Witte).—All methods of synthesising camphor start from the same substance. The chief stages in the transformation are as follows:—(i.) Pinene hydrochloride is obtained by the action of hydrochloric acid, and is purified; (ii.) camphene is obtained by eliminating two molecules of hydrochloric acid from pinene hydrochloride by means of mineral or organic bases or salts of weak acids. There are many different ways of bringing about this transformation; (iii.) isoborneol acetate is obtained by the action of sulphuric acid upon an acetic solution of camphene; (iv.) Borneal is obtained by the isomensation of isoborneol by means of the alkaline or alkaline earth metals; (v.) camphor is the acetone of borneol and the oxidation can be effected in many different ways, such as by the use of nitric acid. These processes can be modified, as, for example, by transforming pinene hydrochloride directly into isoborneyl, either by the action of fatty acids in presence of zinc chloride. Camphene can also be transformed directly into camphor by oxidation. (Chem. Ztg., 1921, p. 118.)

Tetrahydronaphthalene "Tetralin" in Combustion Engines.—(E. de Gramm).—Tetrahydronaphthalene or "tetralin" can

be obtained by the treatment of purified naphthalene with hydrogen in presence of nickel. It is a colourless liquid, with a characteristic smell, boiling at 205°, freezing at -30°C. In physical properties it is intermediate between naphthalene, benzene and petrol, resembling the last in its fluidity, its resistance to cold, and its high ignition point (79°). Unlike petrol, though it gives very gentle explosions and has no tendency to catch fire. It possesses two great advantages: a high specific gravity (·975), and a calorific power which is also high in proportion to the weight, viz., 11·600 calories per kilo, while that of petroleum is only 11·000 calories. In proportion to the volume the calorific power (11·300 calories per litre) is much higher than that of petrol (7·800 calories per litre), or even benzene (8·500 calories per litre). Tetralin cannot be used alone, but gives the best results when mixed with an equal volume of benzene. This mixture can be mixed with alcohol, while tetralin alone does not give a satisfactory mixture with alcohol. (Reine des Produits Chimiques. Dec., 1921, p. 729.)

Mixed Organo-metallic Compound of Aluminium.—(M. Faillelin).—Aluminium dissolves in an unhydrous mixture of methylene iodide and ether, the chief reaction being expressed by the equation $3CH_2I_2+4Al=3CH_2HI+AlI_3$. Aluminium is added to equal volumes of anhydrous ether and methylene iodide containing a little iodine, and the mixture is gently heated. Some of the ether distils over, the liquid becomes cloudy and then colourless and limpid again. Anhydrous ether is then added to prevent the mixture becoming too hot. When the temperature is high or the concentration of the methylene iodide is increased, a secondary reaction takes place, which gives rise to the formation of ethylene, and can probably be expressed by the equation $6CH_2I_2+4Al=3C_2H_4+4AlI_3$. Both these reactions occur with methylene bromide, but the second is less important. In this case the solution forms two layers which might be supposed to be the alumin haloid of the organo metallic substance. Aluminium bromide gives the compound $AlBr_3$. C_4H_1 O with ether, but it is very soluble in ether, and its formation could not account for the existence of the two layers. The lower layer cannot be distilled without undergoing decomposition, and it may be supposed to contain haloid combined with ether. The upper layer, when concentrated again, gives two layers, of which the lower is identical with the preceding, while the upper consists of a liquid which is decomposed by heat. It reacts energetically with water, with liberation of methane in amounts which are proportional to the weight of aluminium used. An aqueous solution is left which contains the halogen salt of the aluminium and alumina; the supernatant ether contains only a small quantity of methylene bromide. Absolute alcohol reacts with the same energy as water, and so also do substances possessing hydroxyl groups, methane being formed. Neither ammonia nor aniline causes the liberation of gas. The organo metallic derivative, according to the formula given, should contain a double bond, and give addition products. This is found to be the case, two atoms of iodine being fixed per atom of aluminium used. When the product is treated with water, no gas is evolved. If the ether is distilled off, and the distillate is shaken with a solution of silver nitrate, an abundant precipitate of silver iodide is formed. The same distillate, after being dried over sodium and treated with magnesium, gives Griquard's reaction. The reactions are: — $CH_3:AlBr+I_2=$ CH_2I. AlBrI.

$CH_2I.AlBrI+H_2O=CH_3I+AlBrI$ (OH).

(Comptes Rendus, CLXXIV., 1922, 112.)

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING *January* 26, 1922.

SIR CHARLES SHERRINGTON, *President*, in the Chair.

The following Papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

PROF. W. A. BONE, D.Sc., F.R.S., A. R. PEARSON, M.Sc., LL.B., E. SINKINSON, B.Sc., D.I.C., and W. E. STOCKINGS, M.Sc. Researches on the Chemistry of Coal. Part II.—The Resinic Constituents and Coking Propensities of Coals.

In the experimental portion of the paper, which comprises the results of a systematic study of eight coals, specially selected for the purpose, it is shown that prolonged extraction of the same by typical resin-

solvents in a Soxhlet apparatus has no appreciable effect upon their coking propensities, which therefore cannot be ascribed to the presence of free resins.

A new method is described for isolation and purification of resins contained in coals; and one so isolated from two typical bituminous coals during the investigation is shown to have a molecular weight of about 450, a composition agreeing well with the empirical formula $C_{31}H_{32}O_3$, and properties corresponding with those of a resene in Tschirch's classification of resins. The amount of such pure resene so isolated in each case did not, however, much exceed 1 per cent. of the weight of coal taken.

It is also shown that the usual pyridine-chloroform method of extracting coal does not, as Clark and Wheeler have claimed, effect "a complete, or nearly complete, separation between the resinous constituents and the degradation products of the cellulose of which coal is conglomerated," but, on the contrary, yields an admixture of resins with a predominance of non-resinous substances, which latter are chiefly of cellulosic origin, and are provisionally designated "humic" bodies in the paper. These are, for the most part, insoluble in ethyl-ether (though soluble in chloroform), and may amount to as much as 4 per cent., or more, of the coal substance in the case of strong coking coals.

It i sconcluded that the coking propensities of such coals are principally due to the presence, or the formation in them by heat, of such non-resinous "humic" substances of cellulosic origin, *whose fusion temperatures are below those at which they undergo rapid decomposition;* although the still more complex substances of cellulosic origin, which form the main portion of the coal substance and decompose without fusion, have little or no influence upon the coking properties.

J. A. CROWTHER, D.Sc., and B. J. SCHONLAND, B.Sc. On the Scattering of β-rays. Communicated by Sir E. Rutherford, F.R.S.

The scattering of a homogeneous beam of β-rays has been measured for various elements, and at various angles with the beam. The results obtained are compared with the nuclear theory of scattering given by Sir Ernest Rutherford, a correction being applied to the theory to allow for the variation of the mass of the β-particle with velocity.

The results show that the scattering observed is due to single encounters between the β-particle and the deflecting particles as postulated by the theory until the thickness of the scattering material is sufficient to reduce the radiation through a given stop to half value.

The scattering by gold is shown to be in numerical agreement with the corrected theory when measured at very small angles with the primary beam. It increases rapidly as the angle is increased, and finally attains a value which is approximately four times that given by the theory. This high value of the scattering is given by the lighter elements at all the angles investigated.

The present theories of scattering would appear to require some modification when the collisions between the β-particle and the deflecting nucleus are closer than a certain critical distance which is of the order of 10 cm. in the case of gold.

ANN CATHERINE DAVIES M.Sc. The Minimum Electron Energies, associated with the Excitation of the Spectra of Helium. Communicated by Sir E. Rutherford, F.R.S.

The conditions of excitation and maintenance of the orthohelium and parhelium series lines, of the enhanced line λ 4686, and of the helium band spectrum have been investigated in detail. The results of the investigation are considered in the light of recent experimental work on the critical potential differences for the production of radiation and of ionisation in helium, and in the light of recent developments in the theory of the possible stationary states of the helium atom, a discussion of which is given in the *Introduction.*

The experiments lead to the conclusion that the lines of the orthohelium and parhelium series are excited only when ionisation of the helium atom has occurred, and that they are all excited simultaneously. The limiting voltages for their excitation are 20·4 and 25·2, according to whether ionisation by multiple impacts can occur or not. The corresponding voltages in the case of the enhanced line 4686 are 54·2 and 80·0 respectively. Evidence was obtained, however, that this line can be excited from the helium positive ion without further ionisation of the atom, at 50·8 volts, the value deduced from Bohr's theory. The minimum

voltage for the appearance of the helium band spectrum is 20·4, and the conditions under which this spectrum appeared support the view that it is emitted by He_2 molecules, for the formation of which electrical excitation of the constituent atoms is essential.

The orthohelium and parhelium lines and the band spectrum were maintained as the voltage was backed down to about 13 volts at high pressures. An interpretation of this, on the basis of Bohr's theory, is given, and it is deduced that the extreme ultra-violet lines of the helium spectrum should be absent when the discharge is maintained below 20·4 volts.

C. N. Hinshelwood, H. Hartley, and B. Topley. The Influence of Temperature on Two Alternative Modes of Decomposition of Formic Acid. Communicated by Prof. J. W. Nicholson, F.R.S.

Formic acid vapour in contact with glass surfaces between 200° and 300° C. decomposes mainly in the following ways:—

$$(a)\ H.COOH = CO_2 + H_2$$
$$(b)\ H.COOH = CO + H_2O$$

The velocities of these simultaneous modes of decomposition have been investigated with a view to throwing further light on the mechanism of heterogeneous catalysis, aud especially on the problem as to whether every molecule with the necessary critical internal energy reacts at once, or whether, in addition to possessing this, the molecule must be in a certain phase. Investigations have hitherto failed to give an unequivocal answer to this question, but the study of the influence of temperature on two simultaneous modes of decomposition of a molecule appeared to offer an opportunity of deciding it.

We find that although the two alternative modes of decomposition of formic acid proceed at approximately equal rates, nevertheless the critical energies calculated from the temperature coefficients of the respective velocity constants are so different that one reaction should predominate almost entirely unless a phase restriction is introduced, and we suggest a possible interpretation of the phase factor in this specific instance.

C. V. Raman, D.Sc. On the Molecular Scattering of Light in Water and the Colour of the Sea. Communicated by Dr. G. T. Walker, F.R.S.

CORNELL UNIVERSITY.

The *Cornell Chemist* for November, 1921, contains a description of the new laboratory of chemistry at the Cornell University. A verl extensive building is proposed, with a floor space of some 216,000 square feet. The building will have five floors and large research laboratories are to be provided for each branch of chemistry. It is expected that the building will be completed in the summer of 1923. The journal gives a full account of the laying of the foundation stone, and of the speeches that were delivered on the occasion. The ceremony is said to have been attended by eminent scholars from all corners of the earth.

Mr. Georye Fisher Baker has made a bift of 1,500,000 dollars for the erection of the chemical laboratory, and personally laid the foundation stone of the buildinb.

Addresses were given by Dr. Edward Leamington Nichols, Professor Edgar Fahs Smith (of the American Chemical Society), Mr. Charles M. Schwab (of the Board of Trustees of Cornell University), and Professor Louis Monroe Dennis (of the department of chemistry).

Mr. Schwab's address was of a highly humorous character, and if space would have permitted we should have been pleased to reproduce it. There is one incident given which applies to England. Mr. Schwab was discussing robes and distinctions generally, and recounted that a short time ago, when in England, he met a man who wore many evidences of distinction, a number of medals and decorations, and he said, "Now that is a man whom I must know." Mr. Schwab went up to him and introduced himself, and asked him if he would tell him why he had so many medals of distinction. He said he would do so with pleasure. He said, "This first large medal you see on my breast I received by mistake, and I got all the others because I had the first one."

In the foundation stone that was laid by Mr. Baker, a copper box was deposited, containing the names of those gentlemen who were associated with the designing and construction of the building, and a great many other items of interest and importance.

If the proposed program is carried out, the Cornell University will undoubtedly have a magnificent laboratory, and cannot fail to do good work in chemical science.

LEEDS UNIVERSITY.

The report of the Advisory Committee on the Departments of Textile Industries, Colour Chemistry and Dyeing and Art, is just to hand. The Committee has received a generous additional grant from the Clothworkers' Co. to assist in the maintenance of their departments through the year 1921-22. And a resolution was passed, expressing the gratitude of the Committee for the generous decision to increase by £1,000 their grant for the session. The money in question will greatly lessen the difficulties of the present financial condition of the departments. The value of the new laboratory in the colour chemistry department has already been proved, and the work is under the direction of Professor A. G. Perkin, F.R.S., with Dr. Forster, late of the British Dyestuffs Corporation, as lecturer, and Mr. W. G. Sewell as assistant lecturer.

The department has a large scale dyehouse for the use of advanced students. A great deal of research work is carried out by the students of the university, and the attendance in all the departments appears to be encouraging.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The Annual General Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, February 1st, when the President, Mr. Alfred Smetham, delivered his annual address.

The following were elected as Officers and Council for the ensuing year:—

OFFICERS AND COUNCIL FOR 1922.
Nominated by the Council.

President: P. A. Ellis Richards.

Past-Presidents Serving on the Council (Limited by the Society's Articles of Association to 8 in number): Leonard Archbutt, A. Chaston Chapman, Bernard Dyer, Otto Hehner, Samuel Rideal, Alfred Smetham, E. W. Voelcker, J. Augustus Voelcker.

Vice-Presidents: F. W. F. Arnaud, C. A. Keane, G. W. Monier-Williams.

Hon. Treasurer: E. Richards Bolton.

Assist. Hon. Sec.: R. G. Pelly.

Other Members of the Council: S. F. Burford, B. A. Burrell, R. L. Collett, C. H. Cribb, B. S. Evans, Norman Evers, Harri Heap, J. H. B. Jenkins, Andrew More, Raymond Ross, W. R. Schoeller, C. J. H.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

Ordinary Meeting, 1st February, 1922, held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards, President, in the Chair.

The following paper was read: "The Quantitative Separation of Nitrobody Mixtures from Nitro-glycerine," by William Dickson, F.I.C., and W. C. Easterbrook.

"*The Quantitative Separation of Nitrobody Mixtures from Nitroglycerine*," by William Dickson, F.I.C., and W. C. Easterbrook.

In the process of explosive analysis it is frequently necessary to separate nitrobody mixtures from nitro-glycerine, as these substances are taken out together in the ether extract.

The authors have worked out a method of determining nitrobody in presence of nitroglycerine depending upon the destruction of nitroglycerine with either ferrous chloride or ferrous sulphate in the presence of methyl alcohol to inhibit a further nitration of the nitrobody. The nitrobody is then recovered by extraction with ether and weighed. The reaction is conducted in the cold to prevent loss of nitrobody by volatilisation. Details of procedure are given by the authors.

THE FARADAY SOCIETY.
ORDINARY MEETING, MONDAY, FEBRUARY 13th, AT 8 p.m.

At the Chemical Society, Burlington House, Piccadilly, W.1.

Papers to be read:—

Prof. J. R. Partington, D.Sc., "The Energy of Gaseous Molecules."

Ulick R. Evans, M.A., "Passivity and Over Potential."

Prof. A. W. Porter, F.R.S., President, "Note on the Vapour Pressure on Ternary Mixtures."

Contributions to the discussions are invited from Members unable to attend the meeting.

A limited number of Advance Proofs of the above papers will be available before the meeting; applications for these to be made to the Secretary. Non-members are asked to enclose 1s. 3d. to cover cost.

The succeeding meeting of the Society will be held on Thursday, March 9th, at 8 p.m., jointly with the Oil and Colour Chemists' Association. A group of papers will be presented for discussion dealing with the properties of powders considered from

The following letter has been issued by the Chemical Society:—

Burlington House, W.1.

Dear Sir or Madam,—For some time past the Councils of the Chemical Society and of the Society of Chemical Industry have had under consideration a scheme of co-operation in connexion with the reading of papers on pure chemistry before the provincial Local Sections of the Society of Chemical Industry, and the scheme has now been approved by both Councils.

Briefly, the arrangement is that the Committees of the provincial Local Sections of the Society of Chemical Industry in Great Britain will give Fellows of the Chemical Society residing in their district the opportunity of reading papers on pure chemistry and of attending the meetings at which such papers are read.

Such papers, if intended for publication in the *Journal of the Chemical Society, should be so marked by the author.* The papers, after presentation to the Local Sections, will be forwarded to us by the Society of Chemical Industry, and will be considered for publication as if they had been communicated to the Chemical Society direct. The additional costs involved in carrying out this scheme will be borne by the Chemical Society.

The Council feels that many Fellows, who may find it impossible, for one reason or another, to come up to London to present their communications, may welcome the opportunity, where it does not exist already, of reading their papers before an audience of their fellow-chemists and having a discussion on the problems raised. The degree of success achieved by this scheme will depend mainly on local energy and collaboration, and the Council trusts that these will not be lacking. It is felt that anything which makes for closer co-operation between the two Societies is to be welcomed, and we hope you will do what you can in this direction.

The Secretaries of the provincial Local Sections of the Society of Chemical Industry are being supplied with lists of the Fellows of the Chemical Society in the respective districts, and if you reside outside the London area, but within reasonable distance of any such local centre, you s[illegible] in due course hear further of this mat[illegible]

We are,

Yours faithfully,

James C. Phillip,

Irvine Masson.

FOR THE COMING SOCIETY MEETINGS.

ROYAL SOCIETY.

List of Probable Papers for Reading on February 16, 1922.

Prof. L. Hill, F.R.S., D. H. Ash, and J. A. Campbell—On the Heating and Cooling of the Body by local Application of Heat and Cold.

Prof. J. B. Cohen, F.R.S., C. H. Browning, R. Gaunt, and R. Gulbransen—*Relationships between anti-septic Action and* chemical Constitution, with special reference to Compounds of the Pyridine, Quinoline, Acridine ,and Phenazene Series.

D. T. Harris—Active Hyperæmia. Communicated by Prof. W. M. Bayliss, F.R.S.

B. B. Sarkar—The Depressor Nerve of the Rabbit. Communicated by Sir E. Sharpey Schafer F.R.S.

Prof. A. Lipschütz, M.D., B. Ottow, M.D., C. Wagner, and F. Bormann—On the Hypertrophy of the Interstitial Cells in the Testicle of the Guinea Pig under *different experimental conditions.* Communicated by Dr. F. H. A. Marshall, F.R.S.

ROYAL INSTITUTION.

A General Meeting of the Members of the Royal Institution was held on the 6th inst., Sir James Crichton-Browne, Vice-President and Treasurer, in the chair. The deaths of Lord Halsbury, a Member, and of Professor Ciamician, an Honorary Member, were reported to the Meeting, and Resolutions of Condolence passed. Mrs. Wilfred Harris, Lady Hope, Miss A. Shenstone, Miss C. H. White and Mr. J. H. Woodward were elected Members.

On Saturday, February 18, Professor Ernest Gardner delivers the first of two Lectures on "Masterpieces of Greek Sculpture." The Friday Evening Discourse on February 17 will be delivered by Professor D. S. M. Watson, on "The History of the Mammalian Ear."

THE INSTITUTION OF ELECTRICAL ENGINEERS, SAVOY PLACE, VICTORIA EMBANKMENT, W.C.2.

Ordinary Meeting, in the Lecture Theatre of the Institution, Savoy Place, Victoria Embankment, W.C.2, *on Thursday, 16th* February, 1922, at 6 p.m. (Light refreshments at 5.30 p.m.). "Rotary Converters, with special reference to Railway Electrifi-

NOTE ON THE MODIFICATION OF DUANE'S APPARATUS FOR PURIFICATION OF RADIUM EMANATION.

In 1915, Professor Duane[1] published a method for the purification of radium as collected from aqueous solution, without the use of liquid air. Collection was effected by mercury displacement by means of a system of glass bulbs which acted as an internal pump. In order to remove oxygen and hydrogen from the gaseous mixture, the gases were passed over an electrically heated, partially oxidized copper wire. The glowing wire causes the hydrogen and oxygen to unite, and the excess of hydrogen is reduced by the copper oxide. The water-vapor formed is removed by a side tube containing P_2O_5. The disadvantage in using an oxidized copper wire as the heating body is twofold. On account of the low resistance of copper, a rather high current, 10 to 15 amperes, must be used initially. As the gas pressure diminishes, the current must be correspondingly diminished in order to avoid overheating of the copper wire.

The modification in the furnace consisted in utilising a platinum wire instead of copper. This has a double advantage in the high melting-point of platinum, and its high resistance. About 5 feet of No. 32 wire was *wound on a small rod of silica 5 mm. in* diameter and 15 cm. long. This was then incased in a thin tube of transparent silica fitting snugly over the spiral coil. It was found that sufficient heat was conducted through the quartz tube to raise an oxidized copper ribbon, wrapped spirally outside of the quartz tube, to a sufficient temperature to cause hydrogen to be reduced. By this indirect heating of oxidized copper the temperature was controlled so that there was no danger of overheating the copper, and a very low current, 1 to 3 amperes, was sufficient. Such a furnace was satisfactory for a period of nearly a year without renewal. The copper had to be reoxidized from time to time, as in the original Duane apparatus.

[1] *Physical Review* (2), 5, 311-314, 1915.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922.

FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—"The Teeth of the Nation."

February 17.—Dr. S. M. Watson, MSc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—"History of the Mammalian Ear."

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin. "The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

January 28.—Dr. C. Macpherson—"The Evolution of Organ Music."

January 31.—Prof. H. H. Turner—"Variable Stars."

February 2. — Sir Napier Shaw — "Droughts and Floods."

ROYAL MICROSCOPICAL SOCIETY.

A Meeting of the Society will be held in the Lecture Hall, 20, Hanover Square, London, W.1, on Wednesday, 15th February, 1922, at 7.30 for 8 p.m., when the following papers will be read:—

Professor B. L. Bhatia, M.Sc., F.Z.S., F.R.M.S.—"Fresh-water Ciliate Protozoa of India."

Mr. A. L. Booth, A.I.C. (Messrs. Armstrong, Whitworth & Co., Ltd.)—"The Microstructure of Coal from an Industrial Standpoint."

Captain Frank Oppenheimer, I.M.S., M.B., Ch.B., F.R.M.S.—"A Portable *Microscope.*"

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

1081—Farbwerke Vorm Meister, Lucius & Brunning.—Process of preparing arsene compounds. January 12.

1288—Goodwin, C. J.—Manufacture of oxides of nitrogen and nitric acid. January 14.

931—Naugatuck Chemical Co.—Processes of vulcanizing rubber. January 11.

712—Royster, G.—Apparatus for neutralizing sulphate of ammonia in its wet state. January 10.

702—Sterling, F. H.—Chemical manometer for determining blood pressure. January 10.

Specifications Published This Week.

173,254—Arnot, R.—Azo dyes obtained from coniferous resins and their process of manufacture.

151,984—Thersell, C. T.—Process for the production of ammonia from cyanides during heating in the presence of water.

173,330—Johnson, J. Y.—Manufacture and production of hydrochloric acid.

173,313—Carpmael, W.—Manufacture of new mordants and process of dyeing basic dyestuffs on cotton.

173,337—Naef, E. E.—Manufacture of metals from their sulphides.

156,135—L. Air Liquide Soc Anon Pour l'Etude et l'Exploitation des Procedes, G.—Synthetic production of ammonia.

Abstract Published This Week.

Sulphur, Carbon.—Patent No. 172,074.—A process for treating sulphur has been devised by Mr. E. E. Naef, of 16, Loughborough Road, West Bridgford, Nottingham. Sulphuretted hydrogen, either alone or mixed with other gases and with or without the presence of ammonia, is partially oxidized by means of highly active carbon, so as to obtain sulphur. Air or oxygen is supplied when necessary. Ammonium sulphide may be similarly treated in aqueous solution. The deposited sulphur is removed from the carbon by solvents. Suitable carbon for use in the process can also be obtained by carbonization at low temperatures of materials such as wood, coconut and other shells, or finely divided anthracite, activated by air or steam at low temperature. Such carbons as these known under the trade marks Elonite or Norite may be used.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3227.

BRITISH INDUSTRIES FAIR.

SOME FACTS AND FIGURES OF THE EIGHTH FAIR.

With reports current on all sides of improving trade conditions, the greatest interest is being taken in the forthcoming British Industries Fair, the eighth of an unbroken series, which will be held from February 27th to March 10th next. The Fair, which is organised by the Department of Overseas Trade, will again consist of two sections, one for such commodities as engineering stock, hardware, tools at Birmingham, and the other for lighter goods at the White City, London.

The two sections will be held concurrently, and in both cases the exhibits will be displayed under one roof, or rather under one series of roofs, for no one building is large enough to hold a complete section of the Fair.

A quarter of a million invitations to buyers in the United Kingdom are being issued during the next few days by the Department of Overseas Trade, and nearly 50,000 have already been sent to buyers overseas. The Fair has also received considerable publicity overseas, and already a considerable number of overseas buyers have written expressing their interest and intimating their intention to attend.

In many of these replies, overseas buyers have raised questions of interest to themselves and British manufacturers, and as a result orders for British firms have already been secured. A point of interest about the Fair is that it is entirely self-supporting, all costs of construction, maintenance, publicity and so on being borne by exhibitors.

With the exception of textiles, the Fair will represent in its two sections practically every British industry. It is open to Dominions manufacturers to exhibit; but middlemen do not participate.

The fact that all the exhibitors are actual manufacturers is of great value to buyers, especially those from overseas, since it eliminates the confusion and waste of time which is apt to arise when the same goods are shown at different prices and in different parts of the Fair. Other advantages for overseas buyers include the free use of a social club equipped with reading and writing rooms, and the free services of interpreters.

Preparations at Castle Bromwich Aerodrome, where the Birmingham Section will be housed, and at the White City, London, are now well advanced, and at both these big buildings the actual exhibits of many firms have already arrived.

Some idea of the size of the Fair can be obtained from the fact that at the White City alone 200 tons of timber and 15 tons of nails have been used in the construction of the exhibitors' stands, which cover 200,000 square feet of actual exhibiting space. These stands, which are being painted to suit the needs of individual exhibitors, have absorbed 20 tons of paints and distempers. Over 10,000 asbestos panels, each weighing half-a-hundredweight, have also been used. The total area of the stand walls amounts to a quarter-of-a-million square feet, the frontage of stands alone being 3½ miles in length. When the stands at Birmingham are added the total distance which a visitor will have to walk to inspect the whole Fair will be well over five miles.

To protect the exhibits, each stand has a muslin ceiling, no less than 12 miles of muslin having been used for this purpose. The counters, which form so prominent a feature of the stands, involve the use of nearly 46 miles of cloth as covering, while floor-coverings amount to 22,500 square yards. In order to ensure adequate light for the whole of these vast preparations, 13 miles of ordinary electric cable and 12 miles of flexible cable have been installed. Through this 25 miles of wire will be conveyed, the current to light 8,000 lamps, each complete with shades and fittings.

These lights are controlled through no fewer than 111 fuse boards, and six miles of straining wire have been used to support this vast mass of electrical material.

In a few days the exhibitors themselves will be busy making the final preparations for the rush of buyers, which will begin on February 27th next.

HOLLAND.

Under the style of "N.V.W.A. Scholtens Chemische Fabrieken," three manufacturers of Groningen have founded, in this town, assisted by German manufacturers, a company with a capital of 240,000 florins, for manufacture of chemicals and trade with England, Belgium, Spain, France, Italy, Luxembourg and Portugal. (Chem. Zeit., 1921; p. 319.)

Ind. Chimique, Déc. 1921.

Contribution from the Department of Chemistry, Cornell University.

GERMANIUM III. GERMANIUM TETRABROMIDE AND GERMANIUM TETRACHLORIDE.[1]

By L. M. Dennis and F. E. Hance.

(*Continued from last Week, February 10th, Page 69.*)

B. Germanium Tetrachloride.

Germanium tetrachloride was first prepared[1] by Clemens Winkler in 1886. He found its specific gravity to be 1.887 at 18°, its boiling point 86°C., and he adds that it did not solidify at —20°C. In our investigations upon the compounds of germanium with the halogens, it seemed desirable to redetermine the above constants of germanium tetrachloride and to study somewhat further the properties of the compound.

Preparation of Germanium Tetrachloride.

In the preparation of germanium tetrabromide by the action of bromine upon germanium that had been prepared by the reduction of germanium dioxide in hydrogen, the very considerable residue of germanium dioxide that remained after action between the metal and bromine had ceased, showed that reduction of germanium dioxide by hydrogen is difficult to carry to completion when fairly large quantities of the oxide are employed. In the preparation of germanium tetrachloride, a large yield was obtained by employing crystalline, fused germanium[2] that had been pulverised and thoroughly freed from any adhering flux.

This metallic germanium was heated in a current of chlorine in an apparatus quite similar to that used for the preparation of germanium tetrabromide, except that the lower boiling point of the tetrachloride rendered necessary a modification of the condensing tube. This was given the shape of a U-tube, to the bend of which there was fused a short tube that terminated in a bulb about 60cc. capacity. The condensed germanium tetrachloride flowed down into this bulb and evaporation of the liquid by the nitrogen and chlorine flowing through the apparatus during the run was thus greatly lessened.

About thirty grams of pulverised germanium was placed in boats in the combustion tube. Purified nitrogen was then passed through the apparatus. A freezing mixture of ice and salt was then packed around the U-tube condenser, the current of nitrogen was turned off, and dry chlorine that had been freed from vapour of sulphuric acid by passage through glass wool was then passed through the apparatus. The temperature of the electric combustion furnace was gradually raised. Reaction between the germanium and chlorine began at about 80°C., and at 180°C. there was rapid combination of the two elements, although the heat of formation of the chloride did not bring the metal to incandescence. When the temperature was raised to 360°C., near the end of the experiment, the metal glowed brilliantly when the chlorine was rapidly passed through the tube.

The germanium tetrachloride was completely condensed in the U-tube. The yield was about 45cc. A very slight reddish-brown residue remained in the porcelain boats. The passage of chlorine was now discontinued, and nitrogen was run through the apparatus while it cooled.

It was found impracticable to free the germanium tetrachloride from chlorine by fractional distillation. Five fractionations gave a final product that still contained some free chlorine. The chlorine was removed by placing the tetrachloride in a distilling flask that had a long neck that was constricted at its lower end and was provided with a side-arm close to its upper end. A cork in the neck carried a glass tube that reached downward into the liquid. The space between this tube and the wall of the neck of the flask was tightly packed with glass wool. The neck of the flask was cooled by a refrigerant on the outside to prevent volatilisation of germanium tetrachloride. The side-arm of the flask was joined to a condenser, and this connected to a U-tube that was packed in a freezing mixture. Upon passing dry air through the liquid at room temperature for seven hours, it was found that the germanium tetrachloride had been freed from chlorine and that only a very small amount of the tetrachloride had been carried over through the condenser.

The residual germanium tetrachloride was then fractionally distilled from the flask. The bulk of the product passed over between 85.2°C. and 85.8°C., and a large middle fraction was obtained that showed a constant boiling point of 85.6°C. The corrected boiling point of germanium tetrachloride is 86.5°C.

[1] J. prakt. Chem., 142 (New Series, 34) 177, 1886.

[2] The manner of its preparation will be described in a later article.

Analysis of Germanium Tetrachloride.

Known amounts of the substance were sealed off in glass capsules. A capsule was broken under absolute alcohol, the solution was diluted with alcohol to 100cc., and separate portions of this solution were used for the determination of chlorine by precipitation with silver nitrate, and for that of germanium with hydrogen sulphide.

	Weight of Ge.	
Wt. of $GeCl_4$.	Found	Calc.
0.04289 G	0.0144 G	0.0145 G
0.04289 G	0.0145 G	0.0145 G
0.1972 G		
0.1970 G		

Weight of Cl.	
Found.	Calc.
0.1301 G	0.1304 G
0.1303 G	0.1303 G

The analysis identifies the substance as germanium tetrachloride.

The Melting Point of Germanium Tetrachloride.

A preliminary determination with a pentane thermometer gave —49°C. as the melting point of the compound. The constant was then accurately determined under the direction and with the assistance of Professor C. C. Bidwell, of the Department of Physics, and we take pleasure in here expressing our appreciation of his kindly co-operation.

The determinations were made with a gold resistance thermometer, the resistance being measured by the fall of potential method. The instrument was calibrated against the boiling points of sulphur and water, the ice point, and the freezing point of mercury.

A test-tube was filled with pure germanium tetrachloride to a depth of 8cm., which sufficed to completely immerse the thermometer. A larger test-tube was brought up around the smaller one to protect the latter from direct contact with the refrigerating agent, liquid air, and to avoid unduly rapid rise of temperature of the frozen samples after the liquid air was removed.

The melting point of germanium tetrachloride was found to be $-49.5 - .2$.

The Index of Refraction of Germanium Tetrachloride.

The measurement was made with an Abbé refractometer, and the index of refraction at 27°C. was found to be 1.3606.

The Specific Gravity of Germanium Tetrachloride.

A pycnometer of 25cc. capacity was thoroughly dried and was filled with ger-

$$\text{Specific gavity, } GeCl_4 \, {}^{25°C.}_{25} = 1.874.$$

Chemical Properties of Germanium Tetrachloride.

Germanium tetrachloride is a colourless, mobile liquid that fumes strongly when brought into contact with the air. Our observations of the behaviour of germanium tetrachloride when brought into contact with water, are substantially identical with those of Winkler.[1] Of peculiar interest is the crackling sound that is emitted when the two substances interact. If the container is not shaken, this snapping persists for hours, and can be heard at a distance of six feet.

When germanium tetrachloride is dropped into concentrated sulphuric acid of room temperature, it sinks to the bottom of the tube and is not attacked by the acid even on long standing.[1]

Germanium tetrachloride reacts violently with a 1:4 solution of potassium hydroxide, the heat of reaction causing the distillation of some of the tetrachloride before interaction is complete. The germanium dioxide that forms and dissolves in the excess of the reagent is precipitable by carbon dioxide.

When germanium tetrachloride is dropped into concentrated nitric acid, it sinks to the bottom and slow reduction of the acid takes place at the surface of contact between the two liquids. The tetrachloride becomes yellow in colour, but remains clear. Vigorous agitation somewhat hastens the reaction, but does not cause immediate decomposition of the tetrachloride. If the container is not shaken, a considerable portion of the tetrachloride still remains unattacked after 48 hours. Upon dilution of the acid with half its volume of water, however, a slow but steady decomposition of the tetrachloride ensues.

When ammonia is passed into germanium tetrachloride, much heat is evolved and a white precipitate is formed. This substance is now being subjected to further study.

Germanium tetrachloride is soluble in absolute alcohol, carbon bisulphide, carbon tetrachloride, benzene, chloroform, and ether. It dissolves in acetone with the formation of a light, orange-coloured liquid.

Summary.

This article deals with the preparation and purification of germanium tetrabromide and germanium tetrachloride, analyses of the

[1] Loc. cit.

two substances, determination of the boiling point, melting point, index of refraction, specific gravity, and some of the chemical properties of the two compounds, and the crystal form and electrical conductivity of germanium tetrabromide.

Ithaca, N.Y.

FRIEND'S THEORY OF VALENCY.

By J. D. Main Smith, B.Sc.

A further contribution by J. A. N. Friend to the chemical literature of the theory of valency has recently been published under the title of "Electrochemical Conceptions of Valency" (*Journal of the Chemical Society*, 1921, 119, 1040). The author partly recapitulates, and, in the light of recent physical and chemical advances, partly amends and elaborates the theory propounded by him in 1908. The present paper, however, commands attention chiefly in its relation to Werner's co-ordination theory.

Friend claims that Sir J. J. Thomson's physical theory of valency, of which a complete account has recently been published (*Phil. Mag.*, 1921 (vi.), 41, 510), offers "interesting physical interpretations of the essential features of the purely chemical theory of valency suggested by the present author (Friend) in 1908." From the purely electrical standpoint, Thomson distinguishes two kinds of valency—(i.) "*non-ionised valency*" in the union of two atoms without interchange of electrons, the resulting compound conforming to Maxwell's law connecting specific inductive capacity and refractive index, and (ii.) "*ionised valency*" in the union of two atoms, one of which has surrendered one electron or more to the other, the resulting compound not conforming to Maxwell's law. Friend identifies (i.) with the *non-polar valency* of Bray and Branch, the *immobile valency* of Lewis, and the *residual* (or *latent*) *valency* of his own theory, and (ii.) with the *polar valency* of Bray and Branch, the *mobile valency* of Lewis, and the *free valency* of his own theory.

Thomson's physical concept is thus bodily translated into a chemical concept, despite that, in the former, ionisation relates solely to electron exchange, whereas in the latter ionisation relates to the dissociation of compounds in solution into ions, entities with separate existence. Many compounds of which the atoms have interchanged electrons are yet non-ionisable in the chemical sense, and therefore belong to Thomson's "non-ionised" category and Friend's residual valency category. Many such compounds combine additively with other compounds to form new compounds which may or may not be ionisable in the chemical sense, and the additional valences are frequently neither in pairs nor yet of equal and and opposite sign as required by Friend's theory. Ammonia, a non-ionising compound, combies with non-ionised boron trichloride or boron trimethyl to form a non-ionisable compound, whereas, with hydrochloric acid, it forms a compound giving two ions in solution. In the first case, ammonia, in Friend's theory, must contain nitrogen having residual valency identical with Thomson's "non-ionised" valency, whereas in the second case the residual valency of the nitrogen atom is half non-ionised in the NH_4 ion, and half ionised in the Cl ion. The fact is that residual valences are chemically sometimes wholly non-ionised, and at other times partly ionised; residual valency cannot, therefore, be identical with "non-ionised," non-polar or immobile valency, nor can free valency be identical with "ionised," polar, or mobile valency. The Cl ion of Ammonium chloride is definitely ionised, polar, or mobile, and cannot be simultaneously non-ionised, non-polar, or immobile, though it is definitely equivalent to one-half the residual valency of nitrogen. The evidence gathered in support of Werner's co-ordination theory has conclusively demonstrated the rule that residual valences in pairs of equal and opposite sign exist only when the principal valences join atoms chemically undissociable into ions, and lends weight to the argument, that in such cases only one valence of a pair is a true residual valence, the other apparent valence being a principal valency of the atom bound by residual valence.

One salient point that emerges from Friend's paper is that neither in his, nor probably any other theory, can chemical ionic dissociation be a criterion of valency. Nevertheless, any theory of valency, not broadly founded on the facts of chemical ionic dissociation, can have but a limited applicability and slight hope of acceptance among chemists. It is rather remarkable that Friend ignores that the phenomena of chemical ionisation have an explicit as well as an implicit explanation in Werner's co-ordination theory, with which he is in partial agreement. The latter theory is con-

ılency, and one hydrogen atom by residual finity, and all four hydrogen atoms to be on-ionisable, and the principal valence of ıe fourth hydrogen atom to be united to an n, the chlorine atom. This follows from ıe maximum co-ordination number *four* or nitrogen, and the rule that the maximum umber *of ions associated with a complex* equal to the principal valency of the oms bound by residual affinity. Friend, owever, states that the co-ordination eory, " breaks down entirely when applied simple inorganic compounds, such as mmonium chloride, containing only ionised *ılencies.*" If this were true, ammonium iloride should give six ions in solution, hereas it gives two, chlorine with one obile valence, and the ammonium radical ith four immobile valences.

Potassium platinichloride is shown in riend's paper with tervalent chlorine oms linked together in a plane hexagonal ng. Nevertheless, Friend assumes the ılorine atoms " to lie at the corners of an ctahedron." This being so, the chlorine oms *must* be *quinquevalent, not terva*nt, for every corner of an octahedron is ljacent to four, not two other corners. ach of the two chlorine atoms, with tached potassium atoms, can be displaced nitrogen atoms in the form of ammonia, form a new stable complex. Such nitro*n atoms must be septavalent* if the octaedral structure remains. A similar arguent applies to the cobalt complexes figured aphically as hexagonal rings *but* elseıere described as octahedra. Extending iend's theory to hexammino-cobaltic comexes having very large kationic volume, is evident that the very large octahedral ell of interlinked ammonia groups could ıt retain the cobalt atom of very small omic volume in the interior, unless yet her residual valency forces, to link tother nitrogen and cobalt are assumed, me of the nitrogen atoms in consequence ing *nonavalent*. As yet septa- or nonalent nitrogen has no chemical evidence in favour.

The succinato and cis-isothiocyanatobaltic complexes figured as hexagonal ıgs, though also described as octahedra, pear to have no bearing on Friend's eory that could not much better be shown the simplest cobaltammines, and are in y event identical, *as octahedra*, with codination structures, so far as the spatial ations of the groups are concerned. It ust be remarked, however, that in the silver nitrate addition compound, the nonionisable silver atom is almost certainly attached to the sulphur atom, for it is well known that silver, like thallium, has a selective non-ionising affinity for sulphur, and, moreover, Werner has proved that, in the cis-isothnocyanato-complexes, the nitro*gen atom is implicated in the* co-ordination sphere, i.e., is united to cobalt.

With regard to the carbonato- and chromato-pentammines, referred to as " not capable of direct explanation by Werner's theory," it must be stated that in so far as the carbonato- (or chromato-) group is concerned, Friend's explanation is identical with Werner's, one oxygen valence being bound in the complex and non-ionisable and the other valence non-ionisably bound to the carbon (or chromium) atom, which is non-ionisably bound to another oxygen atom functioning as half a bivalent ion anchored to the complex. It is implicit in the coordination theory that only such atoms or groups in a complex as are not co-ordinated with the complex can give their usual analy*tical reactions, and,* so *long* as a *portion of* a polyvalent group is bound in the coordination sphere, the group, as a whole, is unable to furnish the complete polyvalent ion. Nothing further is indicated by Werner's graphic formula. The essential difference between Werner's and Friend's formulæ, is that Werner does *not commit* himself on the question of inter-linking of ammonia, evidence being lacking, whereas *Friend arbitrarily assigns a hexagonal ring* structure of linked nitrogen atoms to a structure described as octahedral.

Friend states that "Werner's theory does not explain the non-ionising character of the complex ion since he himself showed there was no distinction between his *Haupt* and *Neben* valencies." The non-ionisa*bility of the parts of a complex* ion is *itself* some evidence of such lack of distinction; the evidence, however, referred to produced by Werner as to *haupt* and *neben* valency, relates to the effect on polarised light, in which connection no distinction between them could be drawn. The non-existence of the distinction in other directions may yet prove to be an "intelligent anticipation" on the part of Werner.

An explanation of the optical activity of cobalt complexes, based on models constructed in accordance with his shell theory, is promised by Friend, to show that the activity is due to an asymmetric nitrogen atom, not to an asymmetric arrangement

round the cobalt atom. Optically active metallic complexes, however, are known which do not contain nitrogen, e.g., the complex metallic oxalates. Presumably asymmetric carbon atoms might furnish an explanation, though there seems to be no evidence denying to cobalt atoms a spatial distribution of chemical forces not denied to carbon, nitrogen, sulphur, tin and other atoms.

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EDGBASTON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

SULPHOBENZIDE.—*Eug. Grandmougin.*—The author's work confirms the view that sulphobenzide can have only a very limited application in the manufacture of synthetic dyes. On nitration it gives a dinitro derivative which, on reduction with sodium sulphide, yields the corresponding diamido derivative. This can be proved to be the 3-3 compound. It may be regarded as bein gcomposed of two molecules of aniline united by the SO_2 group, and it is interesting to notice that the dyes obtained from it do not differ appreciably in shade from those obtained from aniline. As a rule they do not dye cotton, in spite of their symmetrical constitution. The author compared these dyes with those derived from 4-4′- diamino sulphobenzide, and found that in the latter the chromophoric influence of the sulpho group was much greater than in the dimeta derivatives, and their affinity for cotton was decidedly greater. Nevertheless, the chromophoric power of 4-4′ diamido sulphobenzide is much less than that of $_4$-$_4$′ diamidothioaniline and of benzidine. Thus, while 4-4′ diamido sulphobenzide gives with two molecules of acid H (in alkaline solution), a reddish violet on cotton, the corresponding colour given by $_4$-$_4$′ diamidothioaniline is blue violet, and that of benzidine a greenish blue. Only the latter is of technical importance.

OXIDASIC PROPERTIES OF THORIUM X—*Pierre Lemay and Léon Jaloustre.*—When 50 microgrammes of bromide of thorium x are added to a solution of adrenaline, the solution turns first pink and then brown, showing that oxidation occurs. The action is much more energetic than with the chloride and lactate of manganese. Similarly thorium x causes the appearance of a precipitate of oxymorphine in a solution of morphine hydrochloride. On the other hand the primary alcohols of the fatty series are not oxidised to an appreciable extent by thorium x, nor by the bromides of radium, mesothorium, or radiothorium. (Comptes Rendus, CLXXIV., 1922, No. 3.)

DETERMINATION OF FATTY ACIDS BY THE FORMATION OF THEIR COMPOUNDS WITH URANYL AND SODIUM—*J. Barlot and M. T. Brenet.*—Streng has already pointed out that the sodium ion can be detected by the formation of an insoluble crystalline double acetate of uranyl and sodium. In order that Streng's reaction may occur it is necessary that H ions should exist in the solution. The formation of this double salt can be used to detect either sodium, uranium or acetic acid, and the authors have now extended it to the homologues of acetic acid. They find that it always gives positive results when the fatty acid contains in its chain an even number of consecutive carbon atoms, as, for example, in the acetate, normal butyrate, ordinary valerianate and normal caproate. As regards the acids derived from acetic acid by the substitution of one of the hydrogen atoms of the CH_3 group, the power of giving double salts depends upon the nature of the radical introduced. The three chloro-acetic acids give no reaction, but the phenyl acetate of sodium in presence of uranyl nitrate gives an immediate precipitate of crystalline needles. The formula of this salt is $C_6H_5CH_2CO_2Na(C_6H_5+CH_2CO_2)_2WO_2$. (Comptes Rendus, CLXXIV., 1922, No. 2.)

CHLOROFORM AND PEPSIC DIGESTION—*A. Astruc and E. Renaud.*—Pure chloroform seems to possess only a very slow destructive influence on diastatic activity, the loss of activity of pepsine being almost negligible even after it has been in contact with the chloroform for four days. Chloroform vapour has no action. Water containing chloroform is a good solvent for pepsine and can very well be associated with it in preparations which have to be absorbed in a few days. Chloroformed water is, however, a bad medium for digestion *in vitro*, and exercises a decided retarding action upon digestion. (Journal de Pharmacie et de Chimie, XXV., 1922, No. 3.)

Solution of Novococaine—Adrenaline for Local Anæsthesia—*M. Pierre Breteau.* —When solutions of novococaine sterilised by heat are used, even considerable injections of the anæsthetic often do not give satisfactory results. Novococaine seems to undergo no alteration from the chemical point of view when it is sterilised, but a decided diminution of anæsthetic activity is observed. Neutral solutions of cocaine also lose their activity after a time. This disadvantage can be remedied by dissolving novococaine (1gr.) and adrenaline solution (100 drops of a one-thousandth solution) in 100gr. of distilled water saturated with benzoic acid. Bulls containing 5cc. of this solution are employed. They need not be sterilised, as the benzoic acid acts as an antiseptic and also preserves all the activity. The activity of the solution is remarkable, and only very small quantities need be employed. (Journal de Pharmacie et de Chimie, XXV., 1922, No. 3.)

GENERAL NOTES.

CHEMICAL PROGRESS.

In consequence of the blockade, Russia has given great attention to the question of chemistry in the laboratories of Karpoff, of the Institute of Applied Chemistry; Scientific and Technical Institute; Station for Testing National Patents, &c.

A Special Chemical Department has been instituted in the Superior Board of Economy for new products. A new method has been invented for manufacture of nitric acid and treatment of chromium and its alloys. A study has been made of the employment of sulphur fumes in preparation of copper and apparatus for potassium chlorate. Progress has been made in manufacture of sulphur colours and metaphenylene-diamine; paranitro aniline; naphthylamine and toluidin. The province of Archangel has supplied salicylate; cafein; morphin; codein. Russia also produces magnesia; soda; aluminium; platinum; cellulose; bone meal; artificial camphor; technical muriatic acid and aluminium sulphate without iron. Finally, fuel oil; sun-flower table oils, and soap.

Ind. Chim., January, 1922.

CANCER RESEARCH.

Very useful work seems to have been done by the Imperial Cancer Research Fund, which was founded in 1902, under the patronage of His Majesty, King Edward IVI. It works under the direction of the Royal College of Physicians and the Royal College of Surgeons. The staff acts in close collaboration with various laboratories and hospitals. The President states that the results include:—

1. The recognition of the fact that cancer is not a disease peculiar to civilised man, but occurs in all the races of mankind and in all vertebrate animals, is a direct consequence of our work.
2. Improvements in the form in which the national mortality from cancer is presented in the Registrar-General's reports were introduced in consequence of the statistical investigations carried out by the staff and in collaboration with them.
3. Study of the possibility of the transmission of the disease from one animal to another and its limitations was shown to separate cancer from the known infectious diseases. The danger of association or contact with cancer patients was thus shown to be negligible.
4. The importance of early diagnosis, the local character of cancer at its start, and the possibility of permanent cure by early operation are now the accepted basis of the treatment of cancer, mainly as a result of the experimental demonstration of these facts by our workers.
5. The part played by heredity in cancer was proved by the work done here.
6. In addition to these questions of general interest, severely technical special inquiries have been carried out and the results given to the world in the scientific reports of the Fund.

EDUCATION FOR THE WORKERS.

The recent report of the Welsh District of the Workers' Educational Association for 1921, indicates that numbers of miners, as well as other workmen, are taking advantage of the opportunities afforded by this body for educational advancement.

The value of the movement lies in the fact that it favours no sect or any particular school of political thought. It is a corrective against revolutionist ideals; while at the same time it affords a wider outlook to those imbued with reactionary theories. The whole purpose of the Association is, in fact, to educate the worker in the strictest sense of the term. The range of the syllabus is a wide one, and covers a large number of subjects. There are at present something like 2,500 students undergoing the course in the district.

The Coal Industry, February 9th, 1922.

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

(Provisional Report).

Ordinary Meeting—*February* 2, 1922.

Sir Charles Sherrington, *President*, in the Chair.

The following Papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

C. Shearer, F.R.S. On the Oxidation Processes of the Echinoderm Egg during Fertilisation.

The oxygen consumption and the carbon-dioxide out-put of the eggs of the sea-urchin *E. microtuberculatus* during fertilisation has been measured in a definitive quantative manner, by means of a special form of the Barcroft differential manometer, in which it was possible to bring about the fertilisation of the eggs in the closed chambers of the apparatus. An immediate con sumption of oxygen and a corresponding out-put of carbon dioxide takes place on the sperm being added to the eggs. At the end of one minute, this increase is equivalent to a rise in the metabolic rate of the egg of more than 8,000 per cent. The study of sections of fixed material preserved during different intervals of the process of fertilisation shows that this initial increase of the oxidation rate of the egg is brought about by the contact of the sperm with the external surface of the egg membrane, and before it has entered the egg and formed a definite male pronucleus. The fusion of the male and female pronucleus in the later phases of fertilisation, is without any influence on the curve of the oxygen consumption in this process. It has been demonstrated that the dipeptide Glutathione is present in both ripe germ cells of the sea-urchin *E. miliaris* in appreciahle quantity, but one minute after fertilisation it is found in much greater quantity in the egg in reduced form, and certain evidence is adduced to show that it plays a very important, if not the chief, part in the oxidation processes taking place in the ovum on fertilisation.

J. Schmidt. The Breeding Places of the Eel. Communicated by Mr. C. T. Regan, F.R.S.

By a study of the distribution of the arvæ the author demonstrates that the common or fresh-water eel (*Anguilla anguilla* or *A. vulgaris*) of Europe has only one breeding area, which is situated in the Western Atlantic, south-east of Bermuda. The larvæ are pelagic, and are carried to the east and north-east by the Gulf Stream; their growth and the metamorphosis into the "elver," or young eel, are described, and it is shown that the elvers are three years old. The breeding area of the American eel (*A. chrysypa*) is south-west of that of the European eel, but overlaps it; in the American eel, growth of the larvæ is much more rapid than in the European species, and the elvers are only one year old. This difference in their life-history explains why the European eel is not found in American rivers nor the American eel in Europe; if larvæ of the American eel are carried eastwards, the metamorphosis into the elver, fitted for life on coasts and in rivers, takes place in the middle of the Atlantic; if larvæ of the European eel go north or north-west they reach the American coast two years before the metamorphosis is due.

J. Gray. The Mechanism of Ciliary Movement. Parts I. and II. Communicated by Prof. J. S. Gardiner, F.R.S.

1. *Mechanism of Ciliary Movement.*—The rate of beat of the cilia on the gills of *Olytilus edulis* can be controlled by adjusting the hydrogen ion concentration of the cell interior. The amplitude of the beat can be controlled by an alteration in the osmotic pressure of the external medium.

The structure of the cilium and the form of the normal beat indicates that the energy expended during the effective stroke is derived by the interior of the cell; the cilium is essentially a bundle of elastic fibres, whose tension varies during the different phases of the beat.

The activity on cilia and that of muscle cells appears to depend on the same conditions and on similar mechanisms.

2. *Effect of Ions on the Cell Membrane.*—The normal properties of the cell membrane are only maintained in the presence of divalent cations. As long as the cell wall remains intact, ciliated cells are not permeable to anions; they are, however, permeable to monovalent cations. Ciliary activity may persist when the normal semi-permeable properties of the cell wall have been destroyed.

J. S. Huxley and L. T. Hogben. Experiments on Amphibian Metamorphosis and

Pigment Responses in Relation to Internal Secretions. Communicated by Prof. E. W. MacBride, F.R.S.

1. Salamandra and Triton larvæ may be metamorphosed by immersion in a dilute solution of iodine. Metamorphosis is retarded by low temperature. High temperature at first causes increased growth of the gills.

2. Sexually mature Axolotls can be made to undergo metamorphosis by means of a thyroid diet.

3. Metamorphosis is accompanied by exophthalmos, apparently in all Amphibia.

4. In the case of the Axolotl, the time required for metamorphosis induced by enforced air-breathing is considerably longer than when induced by thyroid-feeding.

5. Administration of iodine free of organic combination, or fresh glandular substance of the prostate and pituitary anterior lobe, is without any effect in relation to the metamorphosis of the Axolotl.

6. Thyroid-feeding continued for seven months was not accompanied by any noteworthy somatic changes in Necterus.

7. Pituitary-feeding (posterior lobe or whole gland) produces a marked temporary dilatation, followed later by excessive contraction of the dermal melanophores in albino Axolotls.

8. Adrenal medulla extract produces, temporarily, complete contraction of the dermal melanophores in the Axolotl.

9. Pineal administration rapidly brings about a striking transient contraction of the dermal melanophores in frog tadpoles. It has, however, no effect upon the melanophores of the Axolotl.

THE GEOLOGICAL SOCIETY OF LONDON.

The following interesting lecture was delivered at the February Meeting of the above Society. (Abstract):—

Mr. Cyril Edward Nowill Bromehead, B.A., F.G.S., delivered a lecture on the "Influence of Geology on the History of London."

The 6-inch Geological Survey maps constructed by the Lecturer were exhibited, and some of the new features pointed out. The small streams now 'buried' are indicated on the maps, and the historical research involved in tracing them led to an appreciation of the connexion between the geology and topography on the one hand, and the original settlement and gradual growth of London on the other. The reasons for the first selection of the site have been dealt with by several writers: below London the wide alluvial marshes formed an impassable obstacle; traffic from the Continent came by the ports of Kent, and, if destined for the north or east of Britain, sought the lowest possible crossing of the Thames. This was near old London Bridge, where the low-level gravel on the south and the Middle Terrace deposits on the north approached close to the river-bank. A settlement was obviously required here, and the northern side was chosen as the higher ground. The gravels provided a dry, healthy soil and an easily accessible water-supply; they crowned twin hills separated by the deep valley of the Walbrook, bounded on the east by the low ground near the Tower and the Lea with its marshes, and on the west by the steep descent to the Fleet; the site was, therefore, easily defensible. The river-face of the hills was naturally more abrupt than it is now, owing to the reclamation of ground from the river; the most ancient embankment lay 60 feet north of the northern side of Thames Street.

The first definite evidence of a permanent settlement was the reference in Tacitus. The early Roman encampment lay east of the Walbrook, and the brickearth on the west around St. Paul's was worked. Later the city expanded until the St. Paul's hill was included, the wall being built in the second half of the 4th century. The great Roman road from Kent (Watling Street) avoided London, and utilised the next ford upstream—at Westminster—on its way to Verulamium and the north-west. The earliest Westminster was a Roman settlement beside the ford, built on a small island of gravel and sand between two mouths of the Tyburn. This settlement could not grow, as did London, since the area of the island, known to the Saxons as Thorney, was small. The road from London to the west joined the St. Albans road at Hyde Park Corner, running along the 'Strand,' where the gravel came close to the river; a spring thrown out from this gravel by the London Clay was utilised for the Roman Bath in Strand Lane.

Throughout Mediæval times London was practically confined to the walled city, a defensible position being essential. The forests of the London-Clay belt on the north

are indicated in Domesday Book and referred to by several writers, notably Fitzstephen, whose Chronicle also mentions many of the springs and wells and the marsh of Moorfields, produced largely by the damming of the Walbrook by the Wall. The same writer mentions that London and Westminster are 'connected by a suburb.' This was along the 'Strand,' and consisted first of great noblemen's houses facing the river and a row of cottages along the north side of the road; this link grew northwards, at first slowly, but in the second half of the 17th century with great rapidity. By the end of that period the whole of the area covered by the Middle-Terrace Gravel was built over, but the northern margin of the gravel was also that of the town for 100 years, the London-Clay belt remaining unoccupied.

The reason for this arrested development was that the gravel provided the water-supply. In early days the City was dependent on many wells sunk through the gravel, some of which were famous, such as Clerkenwell, Holywell, and St. Clement's. In the same was the outlying hamlets (for instance, Putney, Roehampton, Clapham, Brixton, Ealing, Acton, Paddington, Kensington, Islington, etc.) started on the gravel, but later outgrew it, as pointed out by Prestwich in his Presidential Address of 1873. In the City the supply soon became inadequate, or as Stow says, 'decayed,' and sundry means were adopted to supplement it. The conduit system, bringing water in pipes from distant springs, began in 1236; London-Bridge Waterworks pumped water from the Thames by water-wheels from 1582 to 1817; the New River was constructed in 1613, and is still in use. It was not until the 19th century that steam pumps and iron pipes made it possible for the clay area to be occupied, thus linking together the various hamlets that are now the Metropolitan Boroughs.

Some of the ways in which Geology affects London to-day were briefly indicated, and the lecture was illustrated by a number of lantern-slides, reproduced mainly from old maps and prints.

SIR JOHN CASS TECHNICAL INSTITUTION.

The Annual Prize Distribution at the Sir John Cass Technical Institute was held on Wednesday, February 8th, when the prizes were distributed by Professor William Rothenstein, Principal of the Royal College of Art.

The Chairman of the Governing Body, the Rev. J. F. Marr, in giving a summary of the work of the Institute during the past session, stated that the increase in the number of students had been more than maintained, and that the capacity of the Institute, especially in the Science Departments, had been taxed to the utmost.

Twenty students had been engaged in research work during the session, and the total number of investigations published from the Institute had now reached 115.

The Department of Petroleum Technology, which was initiated at the commencement of the present session, is one of the Institute's most important developments, and there were already 150 students in attendance. Representatives of the industry have acted as a Consultative Committee to advise the Governors in respect to the courses of study which have been provided, and the chief oil companies of the London area have given generous support towards the equipment and maintenance of the department.

In the course of an address on "Education and Industry," Professor Rothenstein said he regarded every kind of education as something in the nature of a pursuit after truth. Whereas there was much lip-homage to science and art and the crafts by our merchant princes and captains of industry, these employers did not have the same faith in them as their employees. Commercial men in past civilisations, somehow, knew how to ask for the best, but that was not true of our own civilisation. What we required was a standard of commerce which knew how to utilise what was best in the arts and sciences, for he refused to believe that people, in general, did not value that which was good and beautiful in production.

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING, LONDON, MARCH 8TH AND 9TH, 1922.

PROGRAMME.

Wednesday, March 8th.

10 a.m.—General Meeting of Members in the Hall of the Institution of Mechanical Engineers.

The Report of the Council on the work of the past year will be presented by the President.

The Honorary Treasurer will present his Report.

The results of the Ballots for the Council for 1922 and for the election of new Members will be declared. The new President will be inducted into the Chair, and will deliver his Inaugural Address.

A selection of Papers will be presented and discussed.

1 p.m.—The Meeting will be adjourned.

2.30 p.m.—The adjourned Meeting will be continued.

A further selection of Papers will be presented and discussed.

4.30 p.m.—The Meeting will be adjourned.

7.30 p.m. for 8 p.m.—The Annual Dinner at the Trocadero Restaurant, Piccadilly Circus, W.1.

Thursday, March 9th.

10 a.m.—General Meeting of Members in the Hall of the Institution of Mechanical Engineers.

A selection of papers will be presented and discussed.

12.30 p.m.—The Meeting will be brought to a conclusion.

3 p.m. to 5 p.m.—Visit to the Royal School of Mines, Prince Consort Road, South Kensington, S.W.7.

PAPERS.

The following Communications are expected to be submitted in the order given:—

Wednesday, March 8th. (Morning Session 10 a.m. to 1 p.m.)—"Notes on the Corrosion and Protection of Condenser Tubes," by G. D. BENGOUGH, M.A., D.Sc. Member (Investigator to the Corrosion Research Committee).

Wednesday, March 8th. (Afternoon Session, 2.30 p.m. to 4.30 p.m.)—"The Internal Mechanism of Cold-Work and Recrystallisation in Cupro-Nickel," by FRANK ADCOCK, M.B.E., B.Sc. Member (Teddington).

"The Effect of Impurities on Recrystallisation and Grain Growth," by the Research Staff of the General Electric Company, London. (Work conducted by MAJOR C. J. SMITHELLS, M.Sc.)

"Further Studies in Season-Cracking and its Prevention. Condenser Tubes," by H. MOORE, O.B.E., Ph.D., F.I.C., Member, and S. BECKINSALE, B.Sc., Member (Woolwich).

Thursday, March 9th. (Morning Session, 10 a.m. to 12.30 p.m.)—"The Rate of Combination of Copper and Phosphorus at Various Temperatures," by Professor C. A. EDWARDS, D.Sc., Member of Council, and A. J. MURPHY (Swansea).

Note on "Some Cases of Failure in 'Aluminium' Alloys," by W. ROSENHAIN, D.Sc., F.R.S., Vice-President (Teddington).

"Some Mechanical Properties of the Nickel-Silvers," by Professor F. C. THOMPSON, D.Met., B.Sc., Member, and EDWIN WHITEHEAD (Manchester).

"A Further Study of the Alloys of Aluminium and Zinc," by D. HANSON, D.Sc., Member, and MARIE L. V. GAYLER, M.Sc., Member (Teddington).

Note on "The Assay of Gold Bullion," by ARTHUR WESTWOOD, Member (Birmingham).

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922. FRIDAY EVENING DISCOURSES

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin. - "The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

ROYAL INSTITUTION.

Meetings for the Week.

Saturday, Feb. 18, Prof. E. A. Gardner: Masterpieces of Greek Sculpture, 3. Tuesday, Feb. 21, Sir Arthur Keith: Anthropology of the British Empire, 3. Thursday, day, Feb. 23, Prof. A. G. Perkin: Dyeing, Ancient and Modern, 3. Friday evening, Feb. 24, Prof. John Joly: The Age of the Earth, 9.

THE CHEMICAL SOCIETY.
Burlington House,
Piccadilly,
London, W.1.

ORDINARY SCIENTIFIC MEETING, THURSDAY, FEBRUARY 16TH, 1922, AT 8 P.M.

The following Papers were read:—

A theoretical derivation of the principle of induced alternate polarities.—*A. Lapworth.*

An explanation of the property of induced polarity of atoms and an interpretation of the theory of partial valencies on an electronic basis.—*W. O. Kermack* and *R. Robinson.*

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

1587—Baker, F. E.—Apparatus for testing, etc., colour of small quantities of liquid. Jan. 18.

1697—British Dyestuffs Corporation, Ltd.—Manufacture of chloro-ethyl esters, and treatment of phenols, alcohols, and amino compounds with them. Jan. 19.

1388—Carmichael, & Co., Ltd.—Apparatus for manufacture of sulphuric acid. Jan. 17.

1362—Byrness, C.P.—Separating aldehyde fatty acids. Jan. 16.

1577—Coolbaugh, M. F.—Process of treating ores and concentrates to convert them into sulphates. Jan. 18.

1691—Cumberland Coal, Power & Chemicals, Ltd.—Manufacture of hydrogen or gases rich in hydrogen. Jan. 10.

Specifications Published this Week.

173,538—Hunt, S. B. Process for the production of reactive acid liquor, alcohols, esters, and the like from gaseous hydrocarbons.

173,540—British Dyestuffs Corporation, Ltd.—Manufacture of phenyl glycine compounds.

173,644—Asiatic Petroleum Co., Ltd.—Process and apparatus for dehydrating hydrocarbon emulsions and/or distilling hydrocarbon oils or their products of distillation.

Abstract Published this Week.

Ammonium Sulphate.—Patent No. 172337.—An improved apparatus for treating Ammonium Sulphate has been devised by Mr. R. P. Douglas, of 12, Nelson Square, Bolton. The apparatus is for washing, drying, and neutralising ammonium sulphate crystals, and consists essentially of a receiver bucket having a perforated bottom and a suction vessel which, together with a tube depending from the mouth of the vessel forms a trap for the liquor contained therein. Two forms of the apparatus are described. Having been sucked substantially dry by connecting a vent with a suction device, the crystals in the receiver are washed with a small amount of water, and if a neutral salt be desired, they are then washed with ammonia. Alternatively, the crystals may be treated with steam or gaseous ammonia, in which case the receiver is fitted with a lid having an leaving the bucket, forms a trap with the tube, and then passes through the outlet to the mother liquor tank or saturator. For convenience in transporting, the bucket is provided with trunnions or fittings enabling it to be carried by an overhead system. The bucket is made of wood or cast iron, or, like the suction-vessel, it may be lined or made entirely of lead, copper, or other acid-resisting material.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free, for the official price of 1s. each.

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the MANAGER.

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Stavanger, Norway.

MANUFACTURE OF METHYL ALCOHOL.—The owner of British Patent No. 125945, relating to an Improved Manufacture of Methyl Alcohol, is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the above invention, either by sale of the Patent rights, or by granting Licences to manufacture under royalty.

Enquiries should be addressed to Messrs. Abel & Imray, Chartered Patent Agents, 30, Southampton Buildings, W.C.2."

CHEMICAL STUDENT, age 18, pass Inter Sc. Exam., seeks situation near London in Chemical Trade or Laboratory.—Write W. P., 42, Dingwall Road, Croydon.

THE CHEMICAL NEWS,
VOL. CXXIV., No. 3228.

THE EDUCATION OF CHEMISTS.

At a meeting of the Liverpool and North Western Section of the Institute of Chemistry, held at the London and North Western Hotel, Liverpool, on Thursday, February 9th, R. C. Moore, Esq., M.A., M.Sc., M.Ed., A.I.C., Inspector of Schools to the Liverpool Education Committee, gave a lecture on "The Education of Chemists."

Owing to the illness of the chairman of the Section, H. J. Evans, Esq., B.Sc., F.I.C., Prof. Roberts, M.Sc., F.I.C., was elected to the chair.

There was a good attendance of members representative of all branches of the profession.

The lecturer dealt with the subject in a broad and interesting way. He very largely omitted details and dealt with fundamentals. Those portions of the chemist's education on which there are differences of opinion were considered at length.

Emphasis was laid on the necessity for a thoroughly good training in the basic facts and themes of the subject, together with the importance of a sound knowledge of Physics, Mathematics and Modern Languages.

The place of specialisation in a chemical education was carefully considered, and the chemical courses of three typical modern Universities, viz., Leeds, Liverpool and Sheffield, were discussed as examples of the different views which are held on this subject.

The extent to which a student should have experience of Research Work during his academic life was discussed, together with the allowance that should be made for this work at his examinations. The very wide differences in opinion and policy held on this subject by various University authorities was considered.

The desirability of chemical students spending short periods in works or commercial laboratories during their training period was mentioned. In this connection the lecturer described the arrangements made by a large iron and steel works, on whose staff he formerly was, for receiving a party of about a dozen University students for a period of a month or two during each long

The arrangements and conditions for the award of the new National Certificates in Chemistry to students in Technical Schools and Colleges in England and Wales were considered, and the advantages that would be obtained from them explained.

In conclusion, the fact that professional education did not cease with the obtaining of recognised qualifications was considered, and the educational benefits to be derived from keeping up-to-date in professional matters from the regular reading of one or more technical journals, and from the membership of a professional society were discussed.

An interesting and valuable discussion took place after the lecture. Amongst the contributors to the discussion were Dr. Brislee, Mr. Findley, Prof. Heilbron and Mr. Shepherd.

THE REDUCTION OF FERRIC CHLORIDE.

AN UNUSUAL PROCESS.

By A. Pickles M.Sc., Wyggeston School, Leicester.

It is a generally accepted fact that a solution of ferric chloride is not reduced to the ferrous state by molecular hydrogen. If any reduction should occur, it will most likely be due to the presence in it of hydrocarbons due to the impurities in the zinc or the iron which may be used in its generation.

If pieces of copper are added to ferric chloride solution, it will be noticed after some time that reduction has taken place. The more surface the copper may possess the more rapid the reduction, though even if fine gauze is used the reduction is not very considerable. Acidification of the solution with HCl assists the process to some extent.

The rate of reduction is, however, capable of considerable acceleration in the following manner. The ferric chloride solution is placed in a tall and narrow jar, and pieces of the finest copper gauze added. A delivery tube conveying hydrogen is then placed so that all the hydrogen has to pass over the gauze in its passage through the solution, which is best acidified with dilute HCl. The hydrogen is previously scrubbed by passing over pumice and sulphuric acid, and also through potassium permanganate solution. The reduction of the ferric salt is at first remarkably rapid, especially if fine

chloride is formed at the expense of the copper.

The following results were made as nearly comparitive as possible:—

(1) Reduction using Zn, Acid and $FeCl_3$ together in the usual manner.

Time (Mins.)	3	5	7	10	12	15
$KMnO_4$ (N/10) ccm. per 10ccms.	11.4	17.5	21.5	23.7	24.5	25 Reduction complete

(2) Reduction using molecular hydrogen. Copper gauze 24 meshes to the inch.

Time (mins.)	1	3	5	7	10	12	15
$KMnO_4$ ccms. per 10 ccms.	7.5	13	18	20.6	22.4	26	28

(3) Reduction using molecular hydrogen. Copper gauze 80 meshes to the inch.

Time (mins.)	1	3	5	7	10
$KMnO_4$ ccms. per 10 ccms.	17.5	21	24.9	25	31

The reduction is complete when 10 ccms. of the reaction mixture requires 25 ccms. of N/10 $KMnO_4$ for re-oxidation. It will be noticed in cases 2 and 3 that more than 25 ccms. are required. This is because some of the cuprous chloride produced goes into solution, and, of course, also decolourises permanganate.

It is at once seen that an increase in copper surface increases the rate of reduction. This suggests some adsorption action. This is certainly part of the action, but the fact that the Fe ions carry three charges, the following equation represents part of the mechanism of reduction:—

$$(1)\quad Cu + FeCl_3 = Cu + Fe^{\cdot\cdot\cdot} + 3\,Cl' = Cu^{\cdot} + Fe^{\cdot\cdot} + 3\,Cl' = CuCl + FeCl_2$$

The function of the HCl is to take up the cuprous chloride as soon as formed. Of course, the copper, by virtue of its solution pressure, will tend to send into solution some Cu ions, but on the same reasoning so would nickel. With Nickel, however, the reduction is very much slower than with copper. Also, copper is much further removed from iron in the electro-chemical series than nickel, though, of course, the action is not analogous to that of zinc on copper salt solutions.

If platinum gauze is used, reduction again takes place. Now it is well known that platinum will adsorb hydrogen, and since copper gauze is used in the hydrogenation of methyl alcohol to formaldehyde, it is not

The forces by which a gas is held to a surface are often very great. They are said to be of the order of 10,000 atmospheres, and under that pressure the surface atoms of the copper gauze are no doubt brought into a condition favourable for reaction. The Ionic Potential of the copper is no doubt exceeded, and the ions thereby liberated will at once unite with any oppositely charged ions which may be in the vicinity. Thus we get the formation of Cu_2Cl_2.

That Adsorption may really bring about emission of electrons we have only to consider the increased radio-activity of Thorium Sol over Thorium itself. In the sol form the thorium has a well developed surface, and therefore adsorption effects are bound to be present. Similarly, electrionic emmission is increased by the admission of Hydrogen into an electric arc bulb if the temperature is 1,300 C and the pressure 10^{-8} mm.

* This reduction method is not meant to supplant the older method using zinc and acid, because the indeterminate amount of cuprous salt would make accurate work impossible. But it is an experiment of some interest, and still another case of where Adsorption may play an important part.

NOTE.

Dangers of Carbon Monoxide. — A number of questions were put in the House of Commons on Monday regarding the danger of carbon monoxide in coal gas. Mr. Baldwin, President of the Board of Trade, said that the draft of the special order proposed to be made by the Board of Trade, the effect of which was to prohibit the supply of any gas containing carbon monoxide, unless it had a distinctive pungent smell, had been already approved by a resolution of that House, and the order would be made as soon as the necessary resolution had been passed by the House of Lords. There was no statutory limitation of the proportion of carbon monoxide in gas supplied for domestic purposes. Information was obtained from time to time by the Board of Trade from which it was possible to estimate the proportion of carbon monoxide in the gas. There were very few cases in which it would appear that the proportion would exceed 20 per cent., and,

CHEMICAL NOTICES FROM FOREIGN SOURCES.

The Relations between Chemical Constitution and Therapeutic Properties: Hypnotics—*Paul Putzeys*.—The hypnotic effect of a compound seems to be due to the presence in the molecule of one of the three groups or functions: (i.) The ethyl group C_2H_5; (ii.) the group $>C=O$, aldehyde or ketone function; (iii.) an aliphatic ether haloid function. As is to be expected, the saturated hydrocarbons of the fatty series are all hypnotics, and the soporific properties increase from ethane to pentane. The substitution of the ethyl radical by methyl seems to destroy all soporific properties. Propane is more active than ethane, and it seems to be a general rule that the effect produced by an active radical is greater the longer the chain. The substitution in various molecules of one H atom by C_2H_5 gives a series of products which are excellent hypnotics, although sometimes other dangerous or inconvenient effects may be produced. Thus mercaptan $S\!<^{C_2H_5}_{H}$ has soporific powers, but it is toxic. Its toxicity can be removed by saturating the residual valencies of the sulphur, the product being correspondingly less active. The easiest way to produce this effect is to make mercaptan condense with ordinary acetone, giving a di-thioether, which when oxidised gives the disulphone, sulphonal. It is an excellent hypnotic because it is only slightly soluble, has very little taste, and has usually no effect on the digestive organs. Its action is gradual, and it is not toxic. The cyclic compound barbituric acid, obtained by making an ether of malonic acid react with urea, can be used as the parent substance of a number of hypnotics, of which veronal is the most important. It is obtained when two hydrogen atoms of barbituric acid are replaced by two C_2H_5 groups. It has no effect on the stomach, and is easily and rapidly eliminated, but it has a toxic action. When one C_2H_5 group in it is replaced by C_6H_5 luminal is obtained. It possesses properties like those of veronal, but it is much more active, so that the dose of luminal can be reduced to about one-third of that of veronal. (*Journal de Pharmacie de Belgique*, IV., 1922, No. 6.)

Methods of Determining Carbon in Iron and Steel—*A. Travers*.—The three chief methods of determining carbon in iron and steel are: (i.) the sulphochromic combustion method, with or without previous separation of the iron; (ii.) the Eggertz method; (iii.) direct combustion of the metal in a current of oxygen. The author has subjected the first of these methods to a systematic investigation, employing Wiborg's process, and has found that unless the gases are finally burnt, the method is inexact and does not give the total carbon, except in the case of slowly cooled steels, when the error is not more than 2 to 3 per cent. Wiborg's method, however, is valuable, inasmuch as it throws some light upon the relations between the chemical constitution of steel and its structure. The method known in France as Carnot and Gontal's method, in which the carbon is separated before the sulphochromic acid is used, is, generally speaking, more accurate than the method of direct attack with the acid. It also enables other elements, such as sulphur or special metals, for example, to be concentrated in the residue. (*Chimie et Industrie*, VII., 1922, No. 1.)

Decomposition of Nitrous Acid — *E. Oliveri-Mandala*.—The best way to destroy nitrous acid in presence of nitric acid is to use hydrazoic acid $HNO_2+HN_3=H_2O+N_2O+N_2$. A dilute solution of hydrazoic acid or of sodium hydrazoate is added to a solution containing the nitrous and nitric acids, acidified with acetic acid in the case of nitrates and nitrites. The excess of hydrazoic acid must be boiled away, for it would mask the colourations used in the identification of nitrates and nitrites. A portion of the solution must then be tested for the presence of nitrite with an acetic solution of naphthylamine and sulfanilic acid. If it is still present, more hydrazoic acid must be added and the solution again boiled. When all the nitrite has been destroyed nitric acid can be detected by the usual methods. (*Gazz. Chim. Ital.*, LI., 1921, No. 3.)

Separation of Tin and Antimony in HCl Solution by Means of Sulphuretted Hydrogen—*G. Luff*.—The author has found that from solutions containing from 16 to 40 cc. of concentrated hydrochloric acid (Sp. Gr. 1.19) in 100 cc., all the antimony is precipitated on heating while all the tin remains in solution, provided always that the solutions are filtered when cold. The small amount of antimony not precipitated on heating separates on cooling, while the tin remains in solution. Ammonium chloride

acts in the same way as hydrochloric acid, preventing the precipitation of tin. The details of the best procedure to adopt are as follows:—24 cc. of concentrated hydrochloric acid are added to 100 cc. of a neutral solution containing 16.5gr. of AmCl, and the mixture is heated on a water or a sand bath to 80-85°, a strong current of H_2S being meanwhile passed through the solution. The precipitate of mercury becomes dark red and then black; after half-an-hour the liquid is diluted with its own volume of hot water, and then the temperature is raised to 98-100°, H_2S being passed through for another five minutes. It is then cooled to 30° and filtered through a Gooch filter; thus a colourless filtrate is obtained, which is quite clear and contains no antimony. (*Chem. Ztg.*, XLV., 1921, No. 29.)

GENERAL NOTES.

RESEARCH WORK APPARATUS. — Mr. Briant asked the President of the Board of Trade whether any complaints that scientific apparatus essential for research work was difficult to obtain, owing to the operation of the Safeguarding of Industries Act, had reached his Department? Mr. Baldwin replied that no complaints of the kind had been made to his Department, but he understood that certain complaints had been received by the Department of Scientific and Industrial Research, and that their validity was being investigated.

RAT BAIT FACTORY. — Sir A. Griffith-Boscawen, Minister for Agriculture, informed Lieut.-Col. James that in the present need for national economy, and following the recommendation of the Geddes Committee, the Government proposed to close down the Research Laboratory and Rat Bait Factory at the end of the present financial year. The factory was intended to supply bait free of charge for the destruction of rats on Government premises of all kinds. There were no reliable figures as to the amount of damage done annually in this country by rats, but according to unofficial estimates, the annual damage could not be placed at less than £15,000,000.

DUTY ON SANTONINE. — Mr. Mosley asked the President of the Board of Trade whether any decision had been come to by the Board on the question of an appeal from the decision of the referee on Dec. 10 last, that santonine had been improperly included in the schedule of articles chargeable with duty under Part I. of the Safeguarding of Industries Act? Mr. Baldwin replied: "The judgment in question became effective on 20 Dec. last, when it was signed, and santonine was withdrawn from the lists of dutiable articles as from that date. Notice of its withdrawal was given in the Press.

ZINC CONCENTRATES CONTRACT. — During the debate in the House of Commons last week on the motion for the presentation of an address in reply to the King's Speech, Mr. Wignall, a Labour member, raised the question of the Australian zinc concentrates contract, which was made towards the end of the war between Mr. Hughes, the Premier of Australia, and the British Prime Minister, or someone acting on his behalf. Although the contract served its purpose and was in the interests of the country during the war, for two years now the contract had closed down the British mines.

Mr. Baldwin, President of the Board of Trade, replied that in a week or ten days there would be an estimate on the subject of zinc concentrates, and a full statement would be made then.

ACTION OF LIGHT ON THE HUMAN BODY. —*Committee on Research.* — The Medical Research Council have appointed the following Committee to advise them upon the promotion of researches into the biological actions of light, with a view to obtaining better knowledge of the actions of sunlight and other forms of light upon the human body in health or disease:—

Professor W .M. Bayliss, F.R.S. (chairman), Mr. J. E. Bardnard, Dr. H. H. Dale, F.R.S., Captain S. R. Douglas (late I.M.S.), Sir Henry Gauvain, M.D., Dr. Leonard Hill, F.R.S., and Dr. J. H. Sequeira, F.R.C.P. Dr. Edgar Schuster (secretary).

SAMPLING AND ANALYSIS OF COAL COMMITTEE.—The Fuel Research Board of the Department of Scientific and Industrial Research have appointed a Committee to advise upon the sampling and analysis of coal. The personnel of the Committee is as follows:—

Professor Thomas Gray, D.Sc., Ph.D. (chairman), Professor J. W. Cobb, C.B.E., B.Sc., Mr. J. T. Dunn, D.Sc., Mr. J. S. Flett, O.B.E., D.Sc., LL.D., F.R.S., Mr. G. Nevill Huntly, B.Sc., Mr. S. Roy Illingworth, M.Sc., Mr. J. G. King, F.I.C., Mr. C. H. Lander, D.Sc., Mr. R. Lessing, Ph.D., Mr. C. A. Seyler, B.Sc., Mr. F. S. Sinnatt, M.B.E., M.Sc., Professor R. V. Wheeler, D.Sc. Miss T. Renouf, F.C.S. (Secretary).

It is intended that the methods recommended by the Committee shall be adopted in connection with the Physical and Chemical Survey of the National Coal Resources.

Communications for the Committee should be addressed to the Secretary at 16 and 18, Old Queen Street, Westminster, London, S.W.1.

BRITISH CHEMICAL STANDARD STEEL "U" (*Analytically Standardised Sample*).—The latest sample which is now ready for issue comprises a high carbon steel having a little nickel in it as an impurity. It is of special use as

(1) a standard for carbon by combustion or colour;

(2) a low manganese standard associated with high carbon;

(3) a low nickel standard.

The analyses have been undertaken, as usual, by a number of experienced chemists both in the United Kingdom, France and U.S.A. representing the following interests:

British Government Department.

U.S. Bureau of Standards.

Referee Analysts.—Representing users issuing specifications.

Works Analysts.—Representing makers and users.

The standard figures are as follows:—

CARBON STEEL "U."

		%	%
CARBON (combustion)			1.208
,, (colorimetric)	approx.	1.18	
Silicon	approx.	0.18	
Sulphur evolved as sulphide	approx.	0.043	0.472
Phosphorus	approx.	0.055	
MANGANESE			0.472
Copper	approx.	0.05	
NICKEL			0.608
Chromium	approx.	0.03	
Vanadium		trace.	

The standard turnings may be obtained in 500, 100 or 50 gramme bottles, either direct from Organising Headquarters, 3, Wilson Street, Middlesbrough: or through any of the leading laboratory furnishers at a price just sufficient to cover the cost. A certificate giving the names of the Analysts coöperating, the types of methods used, and a detailed list of the results will be supplied with each bottle.

This sample completes a series of 14 steels containing increments of carbon between 0.03 per cent. and 1.20 per cent., also standardised quantities of the following elements: Si, S, P Mn, As, Ni, Cr, Co, V, W, Ti, and Fe.

The standard may be obtained from the Laboratory and Technical Bureau, 3, Wilson Street, Middlesbrough, England.

THE ROYAL SOCIETY.

ORDINARY MEETING—*February* 9, 1922.

SIR CHARLES SHERRINGTON, *President*, in the Chair.

The following papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

SIR J. ALFRED EWING, K.C.B., F.R.S. —*The Atomic Process in Ferromagnetic Induction.*

The object of the paper is to amend the theory of ferromagnetic induction put forward by the author in 1890, and to describe a new model then suggested. In the old model the Weber elements or ultimate magnetic particles were represented by pivoted magnets whose alignment, in the absence of an impressed field, was determined by the forces which they exerted on one another in virtue of their possessing magnetic moment. Consideration of the magnitude of the deflecting force that is required to break up the rows or pairs in which such magnets group themselves has shown that, when the magnets are set near enough together to make their behaviour agree with one known feature of the magnetising process, it fails quantitatively to agree with another known feature. When the range of stable deflection is sufficiently narrow, the stability becomes far too great.

In the new model the idea of magnetic control is retained, with a Weber element in each atom, but the controlling force is supposed to be exerted between the electrons of the atom itself, namely, between the shell, which is held more or less fixed by its relation to neighbouring atoms, and an inner electron system which constitutes the Weber magnet. The control depends on the difference between two nearly equal

opposing forces; this characteristic enables the model to combine a sufficiently weak control with a narrow range of stable deflection. Models are described whose action reproduces the characteristic ferromagnetic phenomena. In one model the structure is based on the grouping of electrons suggested by Hull in connection with his X-ray analysis of iron crystals; in another the electron orbits are assumed to have the nucleus of the atom at their common focus.

PROF. J. W. NICHOLSON, F.R.S. —*Problems Relating to a Thin Plane Annulus.*

The problems which arise in electrostatics and hydrodynamics in regard to the thin annulus cut from a plane sheet of metal, are of some importance, more especially in regard to electrical instruments of precision such as the electrometer. Their mathematical solution in an exact form is a matter of extreme difficulty, and only first approximations, which can be derived by simple methods, appear to have been used hitherto. In the present paper, higher approximations are obtained, to an order which appears to be effective for most of the applications which are of real importance. It is shown that the actual difference of radii of the circles bounding the annulus is of comparatively small significance in such magnitudes as the electrical capacity of the annulus—a result which could not readily be foreseen. The whole investigation is only carried to the second order of significance, but by a method—treating the annulus as a special case of the elliptic anchor ring—which can readily be extended to any desired order. The convergence of such approximate solutions is not discussed, but it is clearly analogous to the remarkable degree of convergence found by Lord Rayleigh in certain solutions of problems of vibration of discs in which eccentricity is taken into account.

PROF T. H. HAVELOCK, F.R.S.—*The Effect of Shallow Water on Wave Resistance.*

In a previous paper an expression was given for the wave resistance of a surface pressure symmetrical round a point and moving over the surface of deep water. The analysis is now extended so as to include the effect of finite depth of water. The wave resistance is given by a definite integral which is evaluated by numerical and graphical methods, and the results are shown in a set of curves for the variation of wave resistance with velocity for various ratios of the depth of water to the length associated with the pressure distribution. The cases intermediate between deep water and shallow water show the double effect of limited depth, in lowering the principal wave-making velocity and in increasing the effects near the velocity of the wave of translation. The results are discussed in their bearing on experimental data for the effect of shallow water on ship resistance.

R. H. FOWLER and C. N. H. LOCK.—*The Aerodynamics of a Spinning Shell.*—Part II. Communicated by H. W. Richmond, F.R.S.

This paper continues and practically completes the analysis of the experiments described under the same title in "Roy. Soc. Trans.," A, Vol. 221, p. 295 (1920). In these experiments shells were fired from two guns giving different degrees of axial spin to the shell. While the shells fired from the gun giving the more rapid spin were all stable, most of the shells from the other gun were slightly unstable, as shown by the much larger yaw developed. These unstable rounds could not be analysed in the first paper as no suitable method was available. They are analysed here and the results confirm previous results for small yaws in a most satisfactory manner, and extend them in certain cases to larger yaws.

In order to carry out this analysis for yaws up to 35° it is necessary to restrict as little as possible the form of the couple assumed to act on the shell at yaw δ. If the couple is taken in the form $X \sin \delta \, [1 - Y (1 - \cos \delta)]$, where X and Y are constants, a solution of the equations of motion can still be obtained in elliptic functions. This solution is worked out and cast into a practicable form; it proves adequately general and the analysis of the experiments is carried out with its aid.

F. B. PIDDUCK.—*The Kinetic Theory of a Special Type of Rigid Molecule.* Communicated by Prof. S. Chapman, F.R.S.

The accurate methods of Chapman and Enskog in the kinetic theory of gases are applied, with suitable modification, to a type of rigid molecule, with a view to finding how viscosity is affected by energy of rotation, and the relative transport of translational and rotational energy in thermal conduction. The molecule model is one that

has been mentioned by Bryan, a sphere which grips at each collision and rebounds without dissipation of energy. The results lend support to Eucken's views on Chapman's constant f for polyatomic gases.

J. E. Jones, M.Sc., Lecturer in Mathematics in the Victoria University of Manchester.—*On the Velocity Distribution Function and on the Stresses in a Non-Uniform Rarefied Monatomic Gas.* Communicated by Prof. S. Chapman, F.R.S.

The problem of the law of distribution of molecular velocities in a non-uniform gas at normal pressures has been dealt with in recent memoirs by Chapman and Enskog. In the present paper, the case of a rarefied gas has been considered, and the method used embodies certain features which appear to be new. A new "equation of transfer" is obtained which is different in form from that of Maxwell, and which is deduced from Boltzmann's integral equation. The rate of change of molecular properties by collision seems to follow more directly and more easily from this equation than from that used by Maxwell and subsequent writers. From Boltzmann's equation by a method somewhat different from that used by Enskog, a symbolic solution of the velocity distribution is obtained: from the new equation, by an analogous treatment, the exact nature of the function is deduced.

To illustrate the present method, the results obtained by Chapman and Enskog for a normal gas are not assumed, as they might be, but are calculated anew. The treatment is then extended to a rarefied gas and expressions obtained for stresses due to non-uniformity of temperature. The existence of temperature stress terms in a rarefied gas was first demonstrated by Maxwell in the case of his special molecular model, and soon afterwards, by a different method, by Reynolds. There is, however, a discrepancy between the two results.

From the general formulæ obtained in this paper, the results in two special cases are deduced. In the first place, the special Maxwellian model is considered, and Maxwell's result is confirmed: and then, for the first time, the molecular model of a gas consisting of rigid elastic spheres is considered in detail. The numerical coefficient in this case is found to differ by about 20

H. Bateman.—*On the Numerical Solution of Integral Equations.* Communicated by Prof. E. T. Whittaker, F.R.S.

A method is developed for obtaining an approximate solution of an integral equation of Fredholm's type by using an approximate representation of the kernel by means of a double series of known functions. It is shown that one such series can be written down immediately in the form of a determinant and the solution of the integral equation with the approximate kernel can also be written down in the form of a determinant. This method is illustrated by means of a numerical example.

Another method is discussed in which the kernel of the integral equation is represented approximately by a polynomial and some methods of obtaining this representation are suggested.

W. B. Hardy, Sec. R.S., and Ida Doubleday.—*Boundary Lubrication—The Paraffin Series.*

The lubricating properties of normal paraffins and their related acids and alcohols have been studied under the conditions of boundary friction.

Amonton's law, that friction varies as the loads and is independent of the areas, is rigorously true for the same bearing surfaces and lubricants.

The friction is independent of the quantity of lubricant present. It is a linear function of molecular weight, so that $\mu =$ friction $\div$ load $= a - b$ M where M is molecular weight. b is a pure function of chemical constitution; the slope of the curve is greatest for acids and is sensibly the same for paraffins and alcohols.

The effect of changing from one acid to another is merely to shift the curves parallel to themselves. Therefore, for the same chemical series, a is a pure function of the nature of the solid faces.

Each solid face contributes one-half of a, so that, when the solid faces are different, say of materials 1 and 2 respectively, $a = \frac{1}{2}a_1 + \frac{1}{2}a_2$.

Each molecule of lubricant present on the faces contributes a constant quantity to the total effect independently of the total number of molecules present.

ROYAL SOCIETY.

List of Probable Papers for Reading on February 23, 1922.

C. D. Ellis.—*β-ray Spectra and their Meaning.* Communicated by Sir E. Ruther-

Prof. A. E. Conrady.—A Study of the Balance. Communicated by Mr. C. V. Boys, F.R.S.

J. S. Owens, M.D.—Suspended Impurity in the Air. Communicated by Sir Napier Shaw, F.R.S.

R. V. Southwell.—On the Free Transverse Vibrations of a Uniform Circular Disc clamped at its Centre; and on the Effects of Rotation. Communicated by Prof. H. Lamb, F.R.S.

A. E. Oxley.—Magnetism and Atomic Structure, II. The Constitution of the Hydrogen-palladium System and other similar Systems. Communicated by Prof. A. W. Porter, F.R.S.

T. Carleman and Prof. G. H. Hardy, F.R.S. Fourier's Series and Analytic Functions.

Prof. A. McAulay.—Multenions and Differential Invariants, II. and III. Communicated by Mr. W. B. Hardy, Sec. R.S.

"THE INSTITUTION OF RUBBER INDUSTRY."

Meeting at Manchester.

"Rubber Mixes and the Question of Accelerators,"

By Joseph L. Rosenbaum, M.Sc.

At the meeting of the Institution of Rubber Industry, held at the Midland Hotel, on Monday, February 6th, Mr. J. H. C. Brooking, M.I.E.E., presiding, a Paper entitled "Rubber Mixes and the Question of Accelerators," was read by Mr. Joseph L. Rosenbaum, M.Sc.

Mr. Rosenbaum, at the outset of his Paper, said that he proposed to deal with the question of organic accelerators only, and mention would only be made of the inorganic accelerators and of the natural organic accelerators present in crude rubber in those cases where their presence in the same mix had an effect upon the organic accelerators.

Dealing briefly with the historical aspect of the subject, the lecturer pointed out that it was in the researches relating to synthetic rubber that the foundation stone of our modern knowledge of organic accelerators was laid. Synthetic rubber proved very difficult to vulcanise, and this was found to be due to the absence of the so-called impurities always present in natural rubber. When the traces of protein matter were extracted from natural rubber, the remaining material proved very difficult to vulcanise, and when this protein was added to synthetic rubber, satisfactory vulcanisation was easily obtained. As a natural consequence of this discovery of the marked accelerating properties of traces of organic basic compounds, a search was made to see whether simpler artificially prepared organic compounds could not serve the same purpose.

The first practical result of this search was seen in a patent taken out by the Bayer Company in 1912, in which they claimed the use of piperidine as an accelerating agent. This was followed by several similar patents, and finally, in 1914, a patent was taken out claiming the use as vulcanisation accelerators of all organic basic compounds possessing a dissociation constant higher than 1×10^{-8}. Since that time, hundreds of other compounds have been proposed as accelerators, nearly all of them characterised by being basic products. Particular mention was made of the discovery by Peachey in 1914 of the accelerating properties of the nitroso derivatives of dimethyl aniline, di-ethyl aniline, and similar compounds. These compounds are characterised by their accelerating properties being dependent upon the nitroso group and not upon the basicity.

The short historical survey concluded with a description of the zinc salts of complex organic compounds that have been proposed in America and Italy, and also of the method of Dr. Schidrowitz of producing the catalyst in the rubber.

Mr. Rosenbaum then dealt with the mechanism of action of accelerators. He showed that any heat effect produced by reaction of the organic catalyst and sulphur was very small indeed, and could play but a very subsidiary part in accelerating the speed of vulcanisation. Although no general mechanism of action suitable for all accelerators could be formulated, there was no doubt that in the majority of cases reaction with sulphur occurred, and that complex sulphur containing bodies are formed capable of combining with the sulphur in the mixing, thus liberating it in a condition especially suitable for vulcanisation. What the exact nature of this active sulphur is is not known, but reference was made to the work of certain American chemists who hold that it is thio-ozone, *i.e.*, a form of sulphur bearing the same relation to ordinary sulphur as ozone does to oxygen.

Certain accelerators, such as thiocarbanilide or hexamethylene tetramine, or the complex thiocarbamate class, only exert their maximum efficiency in the presence of

zinc oxide, whereas others, such as nitrosodimethylaniline function quite well in a simple rubber mixing.

A remarkable fact with regard to these organic accelerators is that they exert quite an abnormal effect upon the mechanical properties of the rubber as compared with the amount of sulphur that goes into combination with the rubber. It would seem that these accelerators have some direct effect upon the rubber itself, but numerous experiments have failed to reveal any such action.

A resumè of the more important organic accelerators available to-day was given, and included the piperidine compounds and other thiocarbamate derivatives, thiocarbanilide, hexamethylene tetramine, aldehyde ammonia, p-nitrosodimethylaniline, p-phenylene diamine and many others.

Mr. Rosenbaum then described a group of remarkable accelerators he had discovered during his research work in the laboratories of the Hooley Hill Rubber and Chemical Company. The colour bases of the basic dyes were investigated, and it was found that in many cases not only did they possess very marked accelerating efficiency, but that the colour they produced in the vulcanised mixing persisted during vulcanisation even at high temperatures and in the presence of excess of sulphur. A striking case in point was that of methyl violet base. Then other colour bases were discovered which were very good accelerators, but the colour of which was completely destroyed on vulcanisation. Auramine base is an example of this class. Other bases were found which had very good colouring properties, but which only accelerated to a very insignificant extent. Finally, it was found that all the colour bases of the basic organic dyestuffs accelerated the vulcanisation and/or coloured product. This discovery forms the subject matter of British Patent 141412 of 1919.

Dealing with the question of the practical use of accelerators, Mr. Rosenbaum pointed out that the best commercial results could be obtained by diminishing the quantity of sulphur used in the mixing when an accelerator was used. This point had been realised in America, which co[illegible] to eight years ahead of Great [illegible] technology of rubber vulcanis[illegible] tion. Accelerators, whils[illegible] valuable for their time, stea[illegible] saving qualities, had seve[illegible] realised, such as the prevention of sulphuring up or blooming, the improvement of the physical qualities of the rubber, and the improvement in ageing properties. They could also be used in the manufacture of the rubber sheaths for electric cables where it was necessary to have no free sulphur at all in the mixing.

With regard to the toxic properties of accelerators, Mr. Rosenbaum pointed out that these had been rather exaggerated, and showed from his own experience that the use of Accelerene (p-nitrosodimethylaniline) that by efficient supervision and proper selection of workmen, troubles from skin rash and skin irritation could be reduced to a negligible minimum.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next Meeting of the Society will be held on Wednesday, March 1st, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following Papers will be read:—

"The Theobromine Content of Cacao Beans and Cocoa," by RAYMOND V. WADSWORTH.

"The Determination of Aldehydes and Ketones by means of Hydroxylamine," by ALEX. H. BENNETT and F. K. DONOVAN.

"The Value of Fish Scales as a Means of Identification of the Fish used in Manufactured Products," by R. E. ESSERY, B.Sc., A.I.C.

"The Examination of B.P. Ointments," by NORMAN EVERS, B.Sc., F.I.C., and G. D. ELSDON, B.Sc., F.I.C.

INFORMAL DINNER.—Arrangements have been made for Members and their friends to dine together at St. James' Restaurant, 178, Piccadilly (opposite Burlington House) at 6.30 p.m.

THE SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

The Fifth Meeting of the Session was held on Friday, February 3rd, at the Textile Institute, Dr. E. ARDERN, F.I.C., presiding.

Papers entitled "The Estimation of the [illegible]oup in Aromatic Organic Com[illegible] Part 2," and "The Use of Potas[illegible]omate in Volumetric Organic [illegible]" prepared by T. CALLAN, D.Sc., [illegible]nd J. A. RUSSELL HENDERSON,

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"The Estimation of the Nitro Group in Aromatic Organic Compounds."

In this Paper, the authors explain that they have extended the work previously published on the estimation of Nitro Compounds (*J. Soc. Chem. Ind.* XXXIX., 1920, 86T-88T), which dealt with certain difficulties experienced in the determination of aromatic nitro groups by the Knecht-Hibbert reduction method. They confirm the results previously given that the use of titanous chloride for this purpose often gives erroneous results owing to simultaneous chlorination and reduction, and give further examples. The use of titanous sulphate eliminates this source of error. The authors have, however, found that titanous chloride containing a minimum amount of hydrochloric acid in presence of an excess of sulphuric acid acts similarly to titanous sulphate, even with substances such as a-nitronaphthalene which readily chlorinate. Another source of error in the ordinary procedure for the determination of nitro groups by reduction with titanous salts is loss by volatilisation during the boiling necessary for reduction, so that in many cases quantitative results can only be obtaned by working under a reflux condenser. Many examples illustrating these sources of error were given, and the effect of varying the conditions of analysis was also indicated.

p-Nitroaniline was recommended as the ultimate standard against which titanous solutions should be standardised, and it was shown tbat solutions of sodium nitrite, potassium bromate, nitrodiazobenzene chloride solutions, etc., could also be standardised against this substance, and then could be used for the volumetric determination of a considerable number of hydroxy and amino derivatives of benzene and naphthalene. The advantages of having one ultimate standard, *i.e.*, p-nitroaniline for the greater part of the intermediates used in the dye industry were briefly described.

It was shown, contrary to recent published statements, that many substances, in particular mononitrohydrocarbons and their mono- and polychloro- derivatives, could be quantitatively determined with titanous sulphate provided the sources of error above referred to were eliminated, and the experimental conditions described were adhered to. Finally, the results obtained in the analysis of a number of nitro compounds not previously recorded were tabulated.

"The Use of Potassium Bromate in Volumetric Organic Analysis."

In this Paper, the authors gave an account of some of the applications of potassium bromate in volumetric organic analysis. The method, which was first used by Koppeschaar in 1876 for the estimation of phenol, and which has since been employed by many experimenters, notably Vaubel, who has shown its wide application for the estimation of amino and hydroxy aromatic compounds and their derivatives, depends upon the absorption of bromine by the compound under analysis when this is supplied in a nascent condition by the interaction of a standard solution of potassium bromate and excess of potassium bromide in presence of a mineral acid. The authors gave a detailed account of the preparation of the potassium bromate solution, its standardisation, and its application to some substituted phenols and anilines.

The three main factors governing bromination by means of nascent bromine are found to be in the case of aromatic compounds (a) orientation of the groups forming the compound, (b) nature of these groups, and (c) the temperature of the reaction. The effect of these factors in a number of typical bromate titrations was discussed.

The application of the method to the direct estimation of dinitrophenol in picric acid, thiocarhanilide, a substance which has become of some technical importance, diphenylamine, and cinnamic acid, where the bromine is absorbed by addition and not substitution, was descrihed, with details of the analytical procedure required.

The Society of Glass Technology.—The 50th Meeting of the Society of Glass Technology was held at the College of Technology, Dr. M. W. Travers, F.R.S., presiding.

In opening the proceedings, the Chairman said that from very small beginnings the Society had now extended its sphere of operations so as to include a considerable number of members in America, France, Belgium, and Asia. He was not aware of any society of the same size which had such far-reaching influence. Due acknowledgment ought to be paid to such early pioneers in the development of the organisation as Prof. Turner, Prof. Wood, and Mr. Jacobson. He hoped that on the occasion of their 100th Meeting, the Society would [illegible]

tional position than it did at the present moment.

A Paper, entitled, "The Relative Advantages and Disadvantages of Limestone, Burnt Lime, and Slaked Lime as Constituents of Common Glass Batches containing Soda-Ash and Salt-Cake," Part 2, by F. W. Hodkin, B.Sc., A.I.C., and Prof. W. E. S. Turner, D.Sc., was read by Prof. Turner.

The authors stated, in continuation of a Paper read 12 months previously, that, in practice, glass manufacturers, particularly of tank-made glass, had used different forms not only of alkaline material, but also of the lime which constituted the soda-lime glasses. In regard to the alkali it might be supplied in the form of soda-ash or of salt-cake, or, in some cases, of a certain mixture of the two. In the case of the lime it might be burnt lime, slaked lime, or calcium carbonate, which might be limestone or spar, according to the chalk, or some similar form, which after all was the best practice under differing conditions.

In summing up the conclusions of the paper, Prof. Turner said that the melting down of glass was dependent upon a number of conditions, *i.e.*, upon the form of alkali used, the form of lime used, and the relative amounts of lime and soda used. In the case of glasses such as those made for common bottles and used with automatic machines, the soda-ash-burnt lime appeared to be the most readily melted, while the salt-cake-burnt lime was perhaps the slowest. When, however, one dealt with a lime containing glass approaching window glass, or at any rate with an additional 4 per cent. of lime, the form in which the glass melted down was not the burnt lime, but the slaked lime, and that, generally speaking, was the form of alkali employed. With lime-containing glasses, melting could be assisted very considerably by the addition of small quantities of other oxides, particularly magnesia.

A second Paper, entitled, "The Density of Soda Magnesia Glasses and the Calculation of Density in General," by S. English, M.Sc., A.I.C., and Prof. W. E. S. Turner, D.Sc., was taken as read.

Royal Institution. — On Tuesday (February 21) at three o'clock, Sir Arthur Keith began a course of five Lectures at the Royal Institution, on "Anthropological Problems of the British Empire," Series I., "Racial Problems in Asia and Australasia." The Friday evening Discourse on February 24 will be delivered by Professor John Joly, on the "Age of the Earth."

THE ROYAL INSTITUTION OF GREAT BRITAIN.

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LECTURES BEFORE EASTER, 1922.
FRIDAY EVENING DISCOURSES

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the Editor.
SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the Manager.
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New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom *all information relating to Patents, Trade Marks,* and Designs, can be obtained gratuitously.

Latest Patent Applications.

2857—Ashcroft, E. A.—Precipitation of precious metals from cyanide solutions containing them. Jan. 31.

2827—Atack, F. W.—Process for sulphurising organic compounds. Jan. 31

2880—*Carpmael, W.—Manufacture of azo-dye-stuffs.* Jan. 31.

3022—Fairweather, G. H. C.—Production of phospheric acid. Feb. 1.

3130—Lefranc et Cie.—Process for manufacture of butyric acid with recovery of gases of fermentation. Feb. 2.

2809—Whattam, T. W.—Manufacture of b-anthrole. Jan, 31.

Specifications Published this Week.

174,099.—Brynes, C. P.—Process of separating aldehyde fatty acids from the by-products accompanying their production, and the manufacture of soaps from these acids.

174,101—Davis. M. O.—Manufacture of oxy-derivatives of anthraquinone.

174,136—Dawson. W. H.—Manufacture of leuco alizarin bordeaux and derivatives thereof.

151,016—John. H.—Process for the manufacture of condensation products of formaldehyde and carbamide derivatives

174,143—Johnson, J. Y.—Process and apparatus for the extraction of sulphur.

Abstracts Published this Week.

Sulphuric Acid.—Patent No. 173,060.—A new process and plant for producing Sulphuric Acid has been devised by Mr. C. J. Read, of 307, West Glenside Avenue, Glenside, Pennsylvania, U.S.A. A gaseous mixture of sulphur dioxide, nitric oxide, or other higher oxide of nitrogen and air or oxygen is heated, for example, to 200-400°C., and the resulting compounds produced by the union of sulphur trioxide with the nitrogen oxides are absorbed in concentrated sulphuric acid. Sulphuric acid is liberated and nitrogen oxides recovered for re-use by treating this solution, preferably in a separated apparatus with water equivalent to the sulphur dioxide used.

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(14745)

CHEMICAL STUDENT, age 18, pass Inter Sc. Exam., seeks situation near London in Chemical Trade or Laboratory.—Write W. P., 42, Dingwall Road,

THE CHEMICAL NEWS,
VOL. CXXIV., No. 3229.

POSITION OF COAL INDUSTRY.

HOPEFUL OUTLOOK.

One of the worst disservices that could be rendered to our national trade as a whole is to misrepresent the position of the coal-mining industry — the foundation upon which British prosperity has been built.

It is scarcely the fault of large numbers of people if they now actually believe that the industry is doomed, and that the conditions of the workmen in respect of unemployment and wages are indescribably bad. They have derived their information from persons who themselves have little or no knowledge of the actualities of the situation.

The truth is that the industry has been passing through a critical time, but the outlook is now sufficiently promising to justify the hope and expectation of greatly improved conditions in the not remote future. Compared with a year ago, coal to-day is cheap, and the demand, particularly from overseas consumers, distinctly better. It is true that we have not yet reached the pre-war level as regards either prices or volume of trade, but the fact remains that we have made considerable progress along these lines towards economic recovery.

The recapture of the overseas markets formerly held by this country has, however, not been achieved without cost; indeed, the process has involved for the time being the necessity of low wage rates for the miners and the surrender of the owners' profits. Employers and men have had to make common sacrifice in order to set the wheels of industry moving. Export coal prices have been forced down to a competitive level, and this has, in many cases, entailed loss to British exporters, who have wisely adopted the far-sighted policy of re-establishing themselves in overseas markets and relegating price to a secondary position. The vital importance of these markets to Great Britain is realised by every student of economic questions. Their loss would entail the restriction of imports of food and raw materials into this country, and would thus aim a deadly blow at our manufacturing trades, besides forcing up the cost of living.

The system of wages regulation embodied in the Terms of Settlement has resulted in successive reductions in the payments made to the miners, while it has absorbed practically the whole of the profits of the industry. But it is clear that had this expedient not been adopted, there could have been no forward movement in the industry such as is now taking place.

Moreover, the careful adjustment of wage-rates periodically has had the effect of minimising unemployment among the men. It is little realsed that in none of the great industries is there such a proportionately small number of men drawing the "dole" as in coal mining. This is shown by the latest available official figures, which are given in the *Labour Gazette* for January. At the end of last year the estimated number of insured workpeople in the industry was 1,140,670, of which number there were 126,348, or 11.1 per cent., unemployed. Against this, the percentage of unemployed in the iron, steel and allied trades is given as 36.7, for other metals 29.5, and for the cutlery trade 35.1. In the cotton trade there were 98,965, or 17.1 per cent., unemployed out of a total of 577,710, and in the flax, linen, and hemp sections the proportion was 21.2. Shipbuilding, engineering, building, and works construction also show percentages vastly in excess of that of the mining industry.

These trades have had the advantage of the substantial lowering of coal prices, secured at the expense of coal owners and their workpeople, but nevertheless a very consierable proportion of the persons engage in them are now being maintained at the expense of the taxpayers. On the other hand, the mining industry, despite the gloomy pictures painted by the alarmists, is not far from being self-supporting, and is, in an economic sense, in a healthier state than it has been within recent years.

THE ATOMIC THEORY IN 1921.

Presidential Address, Section B., S. African Association for the Advancement of Science, Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S.—In thanking you for the honour of being elected President of this section, I take the opportunity of explaining why I deviate from the customary rule that a presidential address should not resemble an ordinary scientific

paper, but should be of more general interest, in fact not unlike a popular science lecture. The fact is, however, that in the five years since I wrote a presidential address. There has been such a tremendous upheaval of the foundations of chemistry and physics, that it is desirable that someone should take the trouble to assimilate the new views and put them on record in a connected form for the use of South African scientists. This must be my excuse for not attempting the kind of address which might be crystallised in the phrase, "Science for Stockbrokers." The revolution which has taken place is one of very great philosophical interest, and is, briefly speaking, the reduction of chemistry to a branch of physics. This has taken place in three logical steps, the first being the recognition of the fact that all chemical properties of a compound can be explained by the number and the arrangement of the *chemical valencies* of the different elements contained in the compound. All chemical properties are thus referred to the properties of the 92 chemical elements, with the addition of special phenomena solely connected with the *arrangement* of elements among one another. The second step is the periodic law of the elements, whereby the 92 elements are shown to have only about 10 different kinds of valency amongst them. The model atom was invented to explain this. It consists of a hollow sphere containing a minute heavy Kernel* with a *distant* ring or shell of electrons, each of which gives a valency; the shell may consist of any number of electrons between 1 and 10, the number and arrangement thus explaining all the possible kinds of valency, and therefore all the strictly chemical properties. The third step consists in showing that the remaining (non-chemical) properties of the atom, such as weight, depend on the nature of the atom-nucleus. The nucleus of certain familiar chemical elements has recently been broken down by artificial means, thus showing that the atom is not the indivisible minute sphere that it was supposed to be in the 19th century, but is itself a compound of smaller bodies in a special arrangement. Nitrogen, for example, is shown to consist of four particles of weight 3, along with two hydrogen atoms, each being characteristically charged with positive electricity, and the whole being held together by "binding negative electrons" to give mass 14 and charge 5. The particle of mass 3 is also almost certainly itself a combination of 3 hydrogens and an electron. Chemistry and physics, therefore, now depend on two substances only, instead of, as before, on the 92 elements of the chemist. The fundamental conceptions of the new atomic theory are those connected with hydrogen in its three forms, viz. (1) hydrogen-ion (hydrion), the cause of acidity; (2) nascent hydrogen and (3) free hydrogen gas.

A. Hydrion is the fundamental and only weight-substance: it consists of unit weight accompanied by unit positive electricity (=1+); and all the elements, following Prout's hypothesis of 100 years ago, are associations of hydrion with electrons (=0−) in different numbers and arrangements. The function of the innermost electrons is to hold the hydrions together, and this the electrons can do even if they are less in number than the hydrions. This combination of a number of hydrions with a *smaller* number of electrons constitutes an atomic nucleus, which thus possesses a positive electric charge equal to the difference between the numbers of hydrions and electrons present. Thus the nucleus of the element Lithium is conceived to consist of seven hydrions held together by four electrons, and this nucleus, therefore, behaves as possessing 7 units of weight* and 3 positive charges. It is to be noted that the size of the hydrion is somewhat smaller than that of the electron, the diameter of which is 4×10^{-13} cm.

B. Nascent hydrogen in this system is merely atomic as oposed to molecular hydrogen, *i.e.*, it is half of whatever molecular hydrogen (hydrogen gas) is conceived to be, consequently it will clear matters up if we consider a simple case, such as that of adding solium-amalgam (containing very little sodium) to a solution of ferric chloride. In the first half of the action, assuming sufficient dissociation of the water, nascent hydrogen is formed according to the equation, which used to be written:—

Na Hg	+ H+	+ OH′	=	Na	+ Hg
Neutral Metal	Hydrion	Hydroxidion		Sodium ion	Neutral Metal.
+	H	+		OH′	
	"nascent"			Hydroxidion	

* The electron is assumed to be weightless; it is in fact ...

Similarly the second equation, according to the former dispensation, was:—

H	+ Fe···	=	H+
Nascent, neutral pseudometallic	Ferric ion		hydrion
	+ Fe·· ferrous ion		

Now on the modern theory, hydrion is the absolute proton or fundamental unit of matter, and its positive charge is inherent in it and inseparable from it. It follows, therefore, that "nascent hydrogen" is not *uncharged* H, but is *neutral*, viz., H+/ , *i.e.*, hydrion with an electron joined to it. (See Fig. 1.) In order, therefore, to be able to re-write the first equation in the modern way, we must provide an electron, and the equation becomes:—

NaHg /	+	H+	=	Na +Hg
Metal Neutral +H+/ nascent or atomic		Hydrion		Sodium ion

The second equation then becomes:—

H+/ + Fe··· = H + + Fe···/ = H$\pm$ + Fe··

With regard to the last step it is to be remembered that 3 dots means a majority of 3 positive charges: the addition of the (negative) electron reduces the majority to 2. The dots used for positive valency thus merely mean shortage of electrons.

C. Hydrogen gas or molecular hydrogen is known from its c_p/c_v ratio to have a long molecule, far removed from roundness, and since it results from "nascent hydrogen" without addition or subtraction of electricity, its formula must be $(H+^{/})_2$, viz. (H+//H +), *i.e.*, it consists of two pairs of entities, one being hydrion and the other the electron. Now the spatial arrangement of these 4 things cannot be square or tetrahedral, otherwise the molecule would not be "long." It must therefore be either a straight line or a narrow-diamond shaped figure, viz., either (see Fif. 2). We now meet with the chemical fact that lithium hydride exists and that it is at first glance composed of two positive substances Li and H, which is impossible owing to electrical repulsion. Further, in both the above formulations of hydrogen gas the electrons are close together, which also is contrary to hypothesis, since both are negative and would repel one another. Lithium hydride is a sale-like non-metallic material made from lithium metal and hydrogen gas, both of which are electrically *neutral* (not positive): we must therefore assume the equation Li·/ + H+/ = (Li // H +) ,in which the arrangement of the electrons is the same as in hydrogen gas. It is stated, however, that when LiH is melted and electrolysed, lithium metal appears at the kathode and hydrogen gas at the *anode**. Now the kathode is negative, hence the appearance of lithium metal (Li ") is normal. but at the anode we must assume that (H +)// orms a *negative* ion attracted there (see Fig. 3), and that it then loses an electron to the positive anode, giving H + which is nascent hydrogen. We are thus again led to the assumption that hydrogen gas consists of the positive (H +) joined to the negative (H +//) (see Figs. 2, 1 and 3). Some writers get over the difficulty by dissecting the electron itself into a repulsive electric part and an *attractive magnetic part* ,*but this is at present* scarcely credible. Similarly, in methane and other inactive hydrogen compounds, one has to assume that carbon parts with 4 electrons to 4 neutral H atoms giving 4 distant (H+)//groups round the carbon kernel; whereas, on the contrary, in a hydrogen-compound which is a tetrabasic acid (*e.g.*, H_4SiO_4) the hydrogen outside consists of plain hydrions (H+) and the 8 electrons left over are pushed inside close to the kernel, thus $(H+)_2$ ——SiO_4''''''''—— $H +)_2$. Having now dealt fully with hydrogen in its different phases, let us now consider what is the nature of another simple monovalent element. Taking lithium as the simplest case, we remember that we have carried at the conclusion that it consists of a small nucleus composed of 7 hydrions held together by 4 electrons, giving a total positive nucleus charge of 3. Since lithium *metal* is neutral, and lithium in the ionised state positively monovalent, we see that the nucleus must carry two negative electrons just outside it. This combination of nucleus and close electrons is called the "kernel" of the atom. The "kernel" is the same as the "ion" when there are not many outside electrons. Thus lithium *ion* Li is θ(4H+ +θ+3H+θ, in which θ is the electron. It has 7 plus and 6 minus charges, therefore has +1

* Hydrogen appears at the kathode in the electrolysis of water, &c.

valency. Lithium *metal* is the foregoing Li˙ with a seventh electron at a comparatively great distance, viz. [θ (4H+ 4θ 3H+ θ θ] making it electrically neutral. Now the number 3 in the case of lithium, which is both the nuclear charge and the total of the number of *external* electrons (in this case 2+1) coincides with the fact that in the periodic law as ordinarily written, lithium is the third element in order. Similarly beryllium, the fourth element in the ordinary periodic law, has a nuclear charge of 4 and a total of 4 external electrons. Sodium is 8 places higher than lithium, therefore has a nuclear charge of 11 (3+8) and 11 external electrons. The nuclear charge of +11 is the difference between 23 hydrions (giving the weight) and 12 electrons; and as regards the eleven external electrons it is assumed that 10 of them are close to the nucleus, forming along with the nucleus the "kernel" (or "ion") of sodium. Thus Na (the ion) is 5θ(12H 12θ 11H+) 5θ, and sodium *metal* is this kernel with a separate electron at a greater distance, as in the case of lithium. In order to bring out the complete analogy between sodium and lithium it is assumed that the 10 external electrons are arranged so that 2 of them are just outside the nucleus and the other 8 are about twice as far away, all equidistant from the centre, and therefore arranged something like the 8 corners of a cube round the nucleus. This arrangement of 8 electrons, the conception of which is due to Gilbert Lewis, and which is technically called a "completed octet" is assumed from its perfect symmetry to confer chemical inertness, and as a matter of fact sodium ion, except towards electricity, is quite as inert as argon, going through all sorts of chemical actions unchanged. Similarly potassium ion K: is 9θ (20H+ 20θ 19H+)9θ, in which the nucleus with 19 plus charges (potassium is 8 above sodium, *i.e.*, is the 19th element) has 18 external electrons, viz., the arrangement of 10 which exists in sodium, along with another "completed octet," thus giving again a kernel or ion which has no projections and is therefore inert.

(To be continued.)

CHEMICAL NOTICES FROM FOREIGN SOURCES

New Method of Detecting Coco Fat in Butter.—*C. F. Muttelet.*—The author has already pointed out that the presence of a vegetable fat in a fat of animal origin can be detected by determining the melting point of the phyto-sterine formed. Thus the phytosterine from coco fat gives an acetate which melts at 125°, while the phytosterine characteristic of animal fats possesses an acetate which melts at 114-114.2°. In order to detect coco fat in butter, the fatty acids are first treated with digitonine when a precipitate of the digitonide crystallises out. After heating, this is filtered off, washed with chloroform and ether, and then dried. It is then gently boiled with acetic anhydride, and the melting point is determined. In the case of pure butters the melting point of the acetate of cholesterine lies between 113.6 and 114.2°. If coco fat is present, the melting point of the mixtures of the acetates of cholesterine and phytosterine increases progressively with the amount of coco fat present. If 5 per cent. of the adulterant is present the melting point is 114.6°, while if the proportion present is 30 per cent. the melting point is 118°.—(*Comptes Rendus* CLXXIV., 1922, No. 4.)

Auto - Oxidation: Antioxygenes.—*Charles Mouren and Charles Dupraisse.*—The auto-oxidation of many substances can be stopped by the presence of traces of certain compounds, to which the authors have given the name antioxygenes. The faculty seems to be associated with the phenol function. Thus traces of hydroquinione are sufficient to prevent benzoic aldehyde from fixing oxygen. The action seems to last practically indefinitely, and it appears to be of the nature of catalysis. It is not impossible that the therapeutic effects of phenols may be connected with their antioxygenic powers. — (*Comptes Rendus* CLXXIV., 1922, No. 5.)

Two New Molybdo-Malates of Ammonium.—*E. Darmois.*—The study of mixtures of varying proportions of MoO_3, $C_4H\ O_{56}$ and NH_3 by the polarimetric method shows that two *lævo*-rotatory compounds exist of composition MoO_3, $2C_4H_6O_5$, $2NH_3$ and MoO_3, $2C_4H_6\ O_5$, $4NH_3$ respectively. The

former is fairly stable, while the latter is formed only in presence of excess of neutral ammonium malate. The corresponding compounds of sodium and potassium have been isolated. The compounds having the second formula are rather less active than the first. They are decomposed by bases, and the corresponding acids are slightly less *lævo* rotatory than the salts.—(*Comptes Rendus*, CLXXIV., 1922, No. 5.)

ACTION OF SODIUM SULPHITE ON NITROBENZENE.—*MM. Seyewetz and Vignat.*—When a solution of sodium sulphite containing 10 to 20 per cent. of Na_2SO_3 is boiled with nitrobenzene in the proportion of two molecules of sulphite to one of nitrobenzene, the colour turns first orange then reddish brown, and oily drops appear, while the smell of nitrobenzene can no longer be detected. Ammonia is set free as the nitrobenzene is decomposed. Organic solvents extract nothing from the solution. In order to isolate the product the excess of alkaline sulphite must first be neutralised with hydrochloric acid. Then the solution is concentrated till a crystalline mass is obtained, which is extracted with alcohol. After recrystallisation colourless insoluble infusible crystals are obtained. The aqueous solution (obtained by heating) decomposes, carbonates, has an acid reaction, instantly reduces ammoniacal silver nitrate in the cold, and in presence of alkalis develops a latent photographic image. It is coloured violet by iron perchloride. The compound may be a sulphonic amidophenol of formula $C_6H_3 \begin{matrix} .SO_3H \\ .OH \\ .NH_2 \end{matrix}$ It is possible that first of all reduction gives a sulphonic phenylhydroxylamine, according to the equation

$$C_6H_5NO_2 + 2Na_2SO_3 + H_2O = C_6H_4 \begin{matrix} .NHOH \\ .SO_3Na \end{matrix} + Na_2SO_4 + NaOH$$

This unstable hydroxylamine is immediately transformed into orthosulphonic paramidophenol. The liberation of ammonia can be explained by supposing that the soda liberated during the sulphonation on the sulphonic phenylhydrazine, according to the equation

$$2C_6H_4 \begin{matrix} .NHOH \\ .SO_3H \end{matrix} + 6NaOH = 2N + NH_3 + 3C_6H_3 \begin{matrix} .ONa \\ .SO_3Na \end{matrix} + 6H_2O$$

The red colouration produced is due to the formation of azoxybenzene. It is possible to suppress both the red colouration and the liberation of ammonia by adding sodium bicarbonate to the solution of sulphite, and thus transforming it into sodium carbonate. —(*Comptes Rendus*, CLXXIV., 1922, No. 5.)

SEPARATION OF MERCURY FROM COPPER BY ELECTROLYSIS.—*W. Böttger.*—The separation of mercury from copper by electrolysis is easily performed when the two metals are present as nitrates (either mercuric or mercurous salts). The difference of potential between the cathode and the liquid should be 1.4 volt, and the solution should contain 1 to 3 cc. of nitric acid (density 1.4) and 3 cc. of alcohol to about 80 cc. of liquid. The separation is complete at the end of 20 to 30 minutes. When there are chlorine ions in the solution the separation is not complete, and even when ammonia and potassium cyanide are present the values found for copper are always too high.—(*Zeitschr. f. angew. Chem.* XXXIV., 1921, No. 25.)

GENERAL NOTES.

TENDERS INVITED. — *Tinplates, solder, etc., for the Serb Croat Sloveno Kingdom.* —The Commercial Secretary to His Majesty's Legation at Belgrade reports that tenders are invited for the supply free at petroleum store warehouse at Belgrade, of tinplates, tinned wire, solder, etc., required by the Direction of State Monopolies, Belgrade. Sealed offers will be received up to 11 a.m. on the 11th March, and must be addressed, "Uprava Drzavnih Monopola," Belgrade, and marked "Ponuda za Isporuku Materijala za Radionicu Kanti," but should be presented by a representative of the tenderer in order to have a reasonable prospect of success.

A deposit of 10 per cent. of the total amount of the tender is required.

The goods required include:—

1. 30,000 (thirty thousand) kilogrammes of tinplates, 0.32 mm. in thickness, in thickness, in sheets of 250 x 250 mm.
2. 90,000 (ninety thousand) kilogrammes of tinplates, 0.32 mm. in thickness, in sheets of 500 x 370 mm.
3. 150,000 (one hundred and fifty thousand) kilogrammes tinned iron wire of 4 mm. diameter for handles.
4. 3,500 (three thousand five hundred)

kilogrammes of pure solder for soldering tins.

5. 3,500 (three thousand five hundred) kilogrammes of pure lead for soldering tins.
6. 30 kilogrammes (thirty kgs.) "nisador" (sal-ammoniac?) in pieces.
7. 250 (two hundred and fifty) kilogrammes of spirits of salt.

Each tenderer must submit samples of the material offered. The following are the quantities required as samples:—One sheet of tinplate, ½ metre of wire, 250 grammes each of lead, solder, sal-ammoniac and spirits of salts.

A translation of the conditions of tender is available for consultation by United Kingdom firms on application at the Department of Overseas Trade (Room 84), 35, Old Queen Street, London, S.W.1, up to 28th February, when it will be sent to provincial firms in order o fapplication.

The Department is prepared to assist United Kingdom firms in the appointment of suitable agents, or will give names of firms with branches in the Serb-Croat-Slovene Kingdom who may be prepared to handle tenders on behalf of third parties.

Department of Overseas Trade,
35 *Old Queen Street,*

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE is issuing a new series of Reprints, beginning with a selection of communications given at the Edinburgh meeting, 1921, including: — (1) Science and Ethics, by F. H. Griffiths, Sc.D., F.R.S., 9d.; (2) Discussion on the Structure of Molecules, 9d.; (3) Report on Credit, Currency, Finance and Foreign Exchanges, 1s. 6d.; (4) Report on Complex *Stress Distributions in Engineering* Materials, 3s. 6d.; (5) Report on Charts and Pictures for use in Schools, 1s.; (6) Report on the practicability of an International Auxiliary Language, 1s.; (7) Report of the Conference of Delegates of Corresponding Societies, including Sir Richard Gregory's address on the Message of Science, 2s. These are on sale at the office of the Association, Burlington House, Piccadilly.

We have received a copy of one of the "reprints" named in the above list. It is a reprint from the Report of the Meeting, with page number, as it will appear in the Proceedings. It will be a convenience to be able to obtain copies of the B.A. communications separately, but it is difficult to understand why the publishing committee have decided to issue it in such a very striking cover; it is so very unlike a scientific memoir.

REAGENT TO DETECT ACETYLENE.—This reagent, given by N. G. Deniges, consists of
Hydrochlorate of ammonia, 50 grammes.
Crystallised copper sulphate, 25 grammes.
Pure Hydrochloric Acid, 0.5 c.c.
Water, 2.S. to make 250 c.c.

It does not decompose. For employment, 4 to 5 cc. are boiled with 0.3 to 0.4 gr. of copper, and when the liquid is decoloured it is allowed to cool. Bands of filter paper are dipped into the liquid. Whilst yet humid they turn red in presence of acetylene. With acetylenic mono-substitutes the colour is yellow tinted.—(*Bull. Soc. Chim. II.*, 1921; *p.* 1272.) *Revue de Chimie Industrielle, Jan.*, 1922.

A NOTE ON THE BIURET REACTION.—*By Claude William Bourlet, Walter Thomas, and Molly Lindblad.*—The Biuret reaction is so extensively employed in testing for Peptones and Proteins that it appears surprising that it has received so little attention.

Usually the colour developed is ascribed to "The purple cupric salt of Biuret, the amide of Allophanic Acid, NH_2-CO-$CONH_2$."

Prima facie this appears highly improbable. Cupric salts are, almost without exception, blue or green, and although we are acquainted with the double chloride of Copper and Lithium, which is red, and the cupric salts of certain organic acids, which are quite yellow, the existence of a purple copper salt requires strong confirmation.

Subsequent to adding the copper salt the following changes, in the following order, are found to occur in carrying out the reaction experimentally:—

1. The formation of a blue colour throughout the liquid.
2. The change of this blue colour to the characteristic purple colour of the Biuret test.
3. The change of this purple colour to red on standing for some time.
4. The formation of a red precipitate.

This precipitate has been analysed and found to consist of Cuprous oxide.

We have found, too, that the velocity of colour change is greatly accelerated by the addition of electrolytes or neutralisation.

These facts, taken in conjunction, seem to point out that the purple colour is due to the formation of a colloidal solution of Cuprous Oxide.

This view is supported by the fact that the colour can be exactly duplicated by the reduction of copper salts with Glucose in the presence of a peptising agent (Gum Arabic, Starch or Dextrin).

In these cases no Biuret at all can be present.

Finally, as a result of these considerations, we would suggest that the modus operandi of the Biuret Reaction is as follows:—

The initial reaction is the formation of Cupric Hydroxide. This is reduced to Cuprous Hydroxide by the Biuret Peptones or other ameno compounds. Alternatively, the Cupric salt of Biuret may be first formed and reduced to the Cuprous salt, and decomposed with the formation of Cuprous Oxide.

British Non-Ferrous Metals Research Association.—Engineers, whether they build locomotives, ships, or engines of any kind, are among the largest users of non-ferrous metals, and will recognise the important work being conducted by the British Non-Ferrous Metals Research Association, of 71, Temple Row, Birmingham, which has just issued its second annual report. The Association has a membership of over 100 firms, all over the country, including both manufacturers and users of non-ferrous metals. The researches in progress are of a very varied character, and are in many cases of national importance. Apart from investigations of particular importance to the non-ferrous industry itself, such as those on brass casting and on the influence of impurities on the working properties of copper, which latter is being conducted at the National Physical Laboratory by Dr. W. Rosenhain, investigations of more general interest to engineering firms are those on metal polishing and grinding, and on the jointing of metals. The electric melting of non-ferrous metals is also receiving attention, and the Association is performing a public service in conducting its important work on the atmospheric corrosion of non-ferrous metals.

Only by co-operative effort on the lines on which this Association is working can British manufacturers hope to meet the very serious competition which will arise from America and Germany through the technical advances being made in the preparation and treatment of non-ferrous metals. This report is a reassuring indication that the value of research is being more generally recognised by British manufacturers.

This week's *Manchester Guardian Commercial*, in an article on new uses for rubber, says there is a prospect that recently begun experiments in paper-making from rubber will be successful. The writer says:—"Many highly desirable qualities in paper—such as strength, bursting strength and folding resistance—which paper-makers aim at, can be expeditiously given to the paper by the introduction of very small quantities of rubber in the latex form. By increasing the quantity in the final product, and using specific fibres, latex papers of very exceptional properties may be produced. This entirely new use for rubber can give a new stimulus to rubber production, and the ultimate extension of the benefits of rubber and industrial interchange in the rubber growing areas in the fa reast. As rubber latex, when used in paper-making, greatly strengthens many kinds of paper, it will be seen that the opportunity is offered greatly to extend the use of some of the hitherto little regarded fibres which can be obtained in many parts of the Empire. It has been estimated that the paper-production of the world is about 10,000,000 tons a year, and, therefore, if rubber latex was used in the manufacture of half the total, viz., 5,000,000 tons, to produce paper with an average content of 1 per cent. of rubber, 50,000 tons of rubber would be absorbed. Over and above this would be the new uses for paper, and of rubber-containing goods made on a paper-making machine. The use of rubber latex in paper-making has the great advantage that it requires no additional expense in the paper-making process as to new machinery and methods, nor does it interfere with the routine and labour in the mills.

THE PHYSIOLOGY OF PROTEIN METABOLISM.

By *E. P. Cathcart, M.D., D.Sc., F.R.S.* New Edition. P.p. 176. Monographs on Biochemistry. London: Longmans, Green & Co. Price 12s. 6d.

The second edition of this well written monograph follows very closelo the lines of

the first edition, which appeared in 1912. Many of the sections have been re-written in order to bring the book up to date, and to give the work of the past ten years its correct setting. There is only one structural alteration, and that is towards the end of the book, where the sections dealing with the part played by carbohydrates and fats on protein metabolism have been removed from the chapter on "Work" and made to form the material for an extra chapter bearing the title, "The Influence of Carbohydrates and Fats on Protein Metabolism."

The work of Dakin and his collaborators, and still more recently that of Hewitt and Pryde on the importance of molecular structure on metabolism is specially referred to. The author maintains that the molecular structure of food substances has more bearing on certain phases of protein metabolism than the thermochemical changes involved. The importance of the accessory food substances and their influence upon the satisfactory utilisation of foodstuffs by animals is appreciated, but the subject is only briefly discussed, as it is proposed to publish a monograph dealing specially with this subject.

The publishers have accomplished their part of the task well, and there is little doubt but that all those interested in this subject will be deeply grateful to the author for the new edition of this excellent monograph, and for the exhaustive bibliography which it contains.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.—*Read March* 2, 1922.

PROF. L. N. G. FILON, F.R.S., and H. T. JESSOP.—On the Stress-Optical Effect in Transparent Solids strained beyond the Elastic Limit.

W. E. CURTIS.—The Structure of the Band Spectrum of Helium. Communicated by Prof. W. M. Hicks, F.R.S.

S. DATTA.—The Spectrum of Beryllium Fluoride. Communicated by Prof. A. Fowler, F.R.S.

W. G. PALMER.—The Catalytic Activity of Copper, Part III. Communicated by Sir W. Pope, F.R.S.

C. B. JEFFERY, D.Sc.—The Motion of Ellipsoidal Particles immersed in a Viscous Fluid. Communicated by Prof. L. N. G. Filon, F.R.S.

G. B. JEFFERY, D.Sc.—The Rotation of two Circular Cylinders in a Viscous Fluid. Communicated by Prof. L. N. G. Filon, F.R.S .

Provisional Report.

THE ROYAL SOCIETY.—*Ordinary Meeting —February* 16, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the summaries here printed having been supplied by the authors for use at the Meeting:—

PROF. L. HILL, F.R.S., D. H. ASH, and J. A. CAMPBELL. On the Heating and Cooling of the Body by Local Application of Heat and Cold.

Experiments in which the hands were heated or cooled by water showed that the amount of heating or cooling was large, but not constant for a given range of temperature. Some indication of the degree of heating or cooling was obtained from the temperature of the skin over the median vein at the elbow, the thermometer used being coiled and insulated from the air. Loss of 20 to 25 kilo-calories of heat from the hands in 30 minutes, *i.e.*, a loss almost equal to the basal metabolism, did not appreciably affect the body metabolism.

PROF. J. B. COHEN, F.R.S., C. H. BROWNING, R. GAUNT, and R. GULBRANSEN.. Relationships between Antiseptic Action and Chemical Constitution, with Special Reference to Compounds of the Pyridine, Quinoline, Acridine and Phenazine Series.

(1). Certain acridine derivatives (salts of diamino-acridine and the methochloride of this base)are extremely potent antiseptics. Their action is not diminished by protein solutions, such as serum. With a view to studying the relationships between chemical constitution and antiseptic action in the acridine group a series of substances have been investigated, comprising pyridine and quinoline derivatives ("fragments" of the acridine molecule), a number of acridine derivatives, and the closely allied phenazine compounds. None of the "fragments" approximated to diamino-acridine in antiseptic properties. The amino-phenazine derivatives were in general weaker antiseptics than those of diamino-acridine.

(2). The substances of the acridine group which have been investigated gave the following general results:—

(*a*) The presence of amino groups increases antiseptic power.

(*b*) Effectiveness in a serum is a characteristic of compounds with unsubsti-

tuted amino groups and especially of the methochloride of these bases.

(c) In the presence of serum the methochloride is never less potent as an antiseptic than the hydrochloride. In certain instances the methochloride shows a striking superiority.

(d) A series of other radicals introduced in place of the methyl group in the methochloride does not alter the antiseptic action (ethyl, propyl, *n*- and *iso*-butyl, &c.; chloroacetate, chloropropionate, and acetanilide derivatives have also been examined).

(e) Substitution of alkyls in the amino group tends to diminish antiseptic action.

(f) Practical abolition of antiseptic properties results when amino groups are acetylated or are replaced by hydroxyls.

(g) Comparative antiseptic action on organisms of different types (*Staphylococcus aureus* and *B. coli*) shows marked irregular variation.

D. T. HARRIS. Active Hyperæmia. Communicated by Prof. W. M. Bayliss, F.R.S.

1. *The lingual nerve contains true vaso-dilator fibres*, just as the sympathetic contains vaso-constrictor fibres; both are equally independent of the intervention of metabolites.

2. No evidence was found that functional hyperæmia is due either to diminution in vaso-constrictor tone or to increase in vaso-dilator tone.

3. The experiments show that the increased blood-supply during muscular activity is due entirely to the products of metabolism; the absence of a simultaneous excitation of the vaso-dilator nerves during voluntary movement, though probable, is not proved.

4. Of the metabolites estimated, CO_2 and $_a$-OH organic acids were found to be increased.

5. Apart from muscular activity, one function of vaso-dilator nerves was found to be concerned with the control of body temperature: active hyperæmia in the dog's tongue may be induced by reflex excitation of the vaso-dilator nerves through stimulation of heat receptors in the skin.

B. B. SARKAR. The Depressor Nerve of the Rabbit. Communicated by Sir E. Sharpey Schafer, F.R.S.

1. The depressor nerve of the rabbit appears to be connected, at least in part, with a special collection of ganglion-cells in the vagus, distinct from the ganglion of the trunk. This collection may extend a certain distance into the superior laryngeal or may pass into the vagus trunk some distance below the ganglion of the trunk, but in most it lies in close contiguity with and just below that ganglion. The cells of the group in question probably give rise to the afferent fibres of the depressor.

The exact point of origin of the nerve is variable. It is usually formed by two branches, one from the superior laryngeal and one from the vagus. In some cases it is double throughout, in others single. It is connected below by fine branches with the inferior cervical ganglion, and can be traced to the root of the aorta and base of the heart.

2. The size of the nerve and the number of fibres it contains vary in different individuals. The left nerve is generally larger and contains more fibres than the right.

3. The depressor contains not only medium-sized myelinated fibres, but also a considerable number of very fine myelinated fibres, and others which are non-myelinated. *It is, therefore, probably not wholly formed, as has usually been supposed, of afferent fibres*, for these fine myelinated and non-myelinated fibres presumably belong to the autonomic nervous system and are efferent.

PROF. A. LIPSCHUTZ, M.D., B. OTTOW, M.D., C. WAGNER, and F. BORMANN. On the Hypertrophy of the Interstitial Cells in the Testicle of the Guinea Pig under different experimental Conditions. Communicated by Dr. F. H. A. Marshall, F.R.S.

In experiments with partial castration one may observe in small testicular fragments enormous hypertrophy of the interstitial tissue, the number and the size of the interstitial cells being very markedly compensatory one, as is shown by the following experimental evidence:—

A. Hypertrophy of the interstitial cells is not present in all cases of partial castration and very small testicular fragments with a not very much augmented relative number, and consequently with a highly diminished absolute number, of interstitial cells may suffice for a normal masculinisation.

B. On comparing testicular fragments supplied by blood in different ways (a frag-

ment from the upper and a fragment from the under pole of the testicle) one finds that the fragment which seems to be better supplied by blood shows more pronounced tendency to hypertrophy of interstitial cells.

C. Enormous hypertrophy of interstitial cells may take place in an upper testicular fragment, even when the other testicle is present in the body.

D. Marked hypertrophy of interstitial cells may take place when we transform both testicles into upper "fragments," by sectioning the testicle near the under pole and by so cutting away only a very small quantity of testicular mass.

In view of all these experiments it seems clear that hypertrophy of the interstitial cells, as observed in indifferent experimental conditions, has nothing to do with the internal secretory function of the testicle in its relation to the organism as a whole. This hypertrophy is caused by local conditions, and is not brought about in response to general compensating requirements.

ROYAL INSTITUTION.—On Saturday (Mar. 4), Sir Ernest Rutherford begins a course of six lectures on Radioactivity. The Friday Evening discourse on Mar. 3 will be delivered by Dr. C. Morley Wenyon, on Microscopic Parasites and their Carriers.

THE SOCIETY OF DYERS AND COLOURISTS. —*Manchester Section.*—At a meeting of the Manchester Section of the Society of Dyers and Colourists, on Friday, February 17th, Prof. E. Knecht in the chair, Dr. S. Judd Lewis, R.Sc., B.Sc., F.I.C., Ph.C., read a paper entitled "The Quantitative Fluorescence of Cellulose, its Derivatives, and Certain other Substances."

The author of the paper stated that he had found that when an ultra-violet spectrum of wave lengths 3300 to 2100 (which is invisible to the naked eye) is projected on to a sheet of note paper or a piece of bleached cotton fabric, the spectrum becomes "degraded," *i.e.*, the ultra-violet rays become converted into visible rays which can be photographed by means of an ordinary camera. It is found that under the same conditions the various papers and fabrics examined give photographic images of varying intensities according to their composition and mode of manufacture. By acetylating the cellulose its fluorescence is enormously increased while nitration depresses this constant almost to vanishing point. Different forms of cellulose had also been examined, and the results obtained were shown. The various treatments to which cotton fabrics were submitted in bleaching as well as the degree of beating of pulp in paper manufacture all found expression in the photographic images, so that it would appear that an application of the method to the examination of industrial products might be anticipated.

THE COLLOID STATE.—Dr. J. Newton Friend, head of the chemistry department of the Birmingham Municipal Technical School, completed on Friday last a course of five lectures on "The Colloid State." The lectures were designed to appeal specially to science teachers and those engaged in the paint and varnish industries. The attendances were satisfactory, and at the conclusion of the series a hearty vote of thanks was passed to the lecturer, on the motion of Mr. G. King, M.Sc., seconded by Mr. Alcock.

The syllabus of the lectures was: (1) What is a colloid? Characteristic features of the colloid state. Emulsoids and suspensoids. (2) Preparation of sols. Sizes of colloid particles. Optical properties. (3) Electrical and other properties of sols. (4) Emulsions and emulsoids. Gels. (5) Application of colloid chemistry to domestic and technical life.

The word colloid was introduced by Graham to designate substances of a gluey nature that apparently dissolve in water, yielding clear diphasic mixtures. The water is termed the continuous phase, and the glue the disperse phase. Such a system is termed a sol, and differs from a true solution in that the disperse phase will not readily diffuse through parchment or jelly. Graham regarded these gluey substances as a distinct world of matter, but it is now recognised that it is purely a question of the size of the particles of the disperse phase. If the latter is of mere molecular dimensions, an ordinary solution results; if the disperse phase consists of large particles, the mixture is termed a dispersion. Intermediate between these two extremes lies the colloid realm. For the sake of convenience, the colloid range is limited to those particles assumed spherical, whose diameter lies within the arbitrarily fixed range of 1M to 100M. Above this size they are regarded as suspensions, below as molecular solutions.

It would appear, therefore, that all substances may yet be prepared in the colloidal state, if suitable continuous phases can be obtained and on the other hand it

would not appear impossible for Graham's "colloids" to be prepared in a crystalline form. Indeed, in some cases, such as gelatin and agar, this has already been achieved. It is, therefore, preferable to speak of the "colloid state" and to regard it in much the same way as the solid, liquid and gaseous states are regarded, remembering that they all gradually merge the one into the other. The systems most commonly studied are suspensoid and emulsoid, sols, consisting of solid and liquid disperse phases respectively in liquid continuous phases. Thus platinum hydrosol is a suspensoid, the continuous phase being water, whilst starch in similar circumstances yields an emulsoid. Six other systems, however, are possible. Ruby glass owes its colour to the presence of particles of solid gold of colloid size suspended in the solid glass continuous phase. The blue colour of the sky is largely attributable to a solid disperse phase disseminated throughout a gaseous continuous phase.

Dr. Friend dealt more particularly with suspensoids, emulsoids and gels. Suspensoids may be prepared either by dispersion or condensation methods—the latter being the more usual. Red and blue gold sols were prepared by the reductiou of auric chloride with tannic acid, and with hydroxylamine hydrochloride respectively. The variation in colour is due to a difference in the size of the gold particles, the blue being the larger.

Attention was drawn to the retarding action of organic emulsoids upon the rates of many chemical reactions. Experiments were shown, illustrating in a striking manner the reduced corrodibility of iron, lead, zinc and aluminium in emulsoid hydrosols such as those of gelatin, glue, starch, albumin, &c. This is of considerable domestic interest, since in most culinary operations emulsoids find their way into the cooking utensils and thus preserve them from undue corrosion. The retardation was beautifully shown in the case of mercuric iodide, which is normally precipitated from the solution as a labile yellow mass, which rapidly turns red as it changes to the more stable variety. By precipitating the salt in the presence of gelatin, a canary precipitate is obtained which retains its colour unchanged for half an hour or more, according to circumstances, and only very slowly turns to the red form. These retardations are apparently due to adsorption, and in many of the foregoing cases the requirements of the adsorption law are known to be complied with.

Some beautiful Liesegang rings were shown and mock agates produced in blocks of gelatin. Dr. Friend gave his own explanation for their formation. On addition of silver nitrate to the bichromated gelatin, colloidal silver chromate is first formed. The gelatin, however, retards the rate of precipitation of the salt for the reason already given, but diffusion continues until the colloid particles have grown too large, and they then begin to precipitate out. The distance between the rings, therefore, is the algebraic sum of the rates of diffusion and precipitation.

The lectures were fully illustrated with lantern slides, exhibits, and with experiments. The Brownian movement was shown under the ultra-microscope.

VAN DER LINGEN, J. S., AND WOOD, R. W.—The Fluorescence of Mercury Vapor. *Astrophysical Journal*, 54, 149—160, October, 1921. The University of Chicago Press, Chicago, Ill.

ABSTRACT.

The Fluorescent spectrum of mercury vapor cannot be excited in quiescent vapor, but only in vapor which is being distilled from th emetal at a temperature of 150° or more. This proves that the *active molecules* are not neutral monatomic molecules but others present only during distillation, perhaps diatomic molecules. The spectrum consists of three lines—λ2536, 2539, and 2346 A—and four structureless bands with maxima at 2346, 2540, 3300, and 4850 A. While the complete spectrum is excited by light from a zinc spark, single lines excite only part. *The relation of the spectrum to the exciting light* is of great interest. The broad bands with maxima at 3300 and 4850 may be excited, with varying relative intensity, by λ 1854—62, 2346, or 2536—40 A; whereas the band λ 2346—2100 A is excited only by λ 2000—2150 A, the position of the maximum depending on the particular wave-length used. All the effective exciting lines lie, of course, in the absorption spectrum of mercury vapor.—GORDON S. FULCHER.

THE ROYAL INSTITUTION OF GREAT BRITAIN.
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LECTURES BEFORE EASTER, 1922.
FRIDAY EVENING DISCOURSES

March 10.—Thomas R. Merton, D.Sc., F.R.S., *Prof. of Spectroscopy, University* of Oxford.—" Problems in the Variability *of Spectra.*"

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—" The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—" Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of " Drama and Life," etc.—" Jane

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—" Evolution of the Elements."

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3230.

INSTITUTE OF CHEMISTRY.

44TH ANNUAL GENERAL MEETING.—*Report of President's Address.*— At the 44th Annual General Meeting of the Institute of Chemistry, the President, Mr. A. Chaston Chapman, F.R.S., presented the first Meldola Medal to Dr. Christopher Kelk Ingold. The medal, which is the gift of the Society of Maccabæans, has been instituted as a memorial to Prof. Raphael Meldola, a Past-President of both the Institute and the Society, and is awarded for meritorious original work in chemistry conducted by British subjects under thirty years of age.

In the course of his presidential address, Mr. Chaston Chapman said that owing to a variety of causes—foremost among which must be placed the intensive educational effect of the great war—the importance of chemistry to the national well-being was daily becoming more widely and more clearly recognised, and with that recognition had come a great development of the work of the Institute. The Roll of Members had increased during the past twelve months by 371 to over 3,540, and the students by 94 to 983. The organisation of the profession of chemistry was thus being steadil yeffected. The older members had the satisfaction of seeing the Institute placed on a sure foundation, and its position as the hody truly representing professional chemistry in this country, acknowledged alike by chemists, by the general public, an dthe Government.

Referring to the scheme recently inaugurated under arrangements made with the Board of Education for the award of National Certificates in Chemistry to students in technical schools in England and Wales, the president remarked on the advantage of bringing such students at an early age into touch with the professional qualifying body. Later, when the scheme was in operation, the Council would consider whether and to what extent the certificates should be allowed to rank towards the fulfilment of the conditions required for admission to the examination for the Associateship of the Institute.

In an open and comparatively young profession such as chemistry, it was necessary that the public should understand clearly the nature of the work in which the members were engaged. He did not believe that any single cause had contributed so greatly to retarding in the past the progress of the profession of chemistry in this country as the misapplication of the word *chemist*. In no other country was there any confusion between the person who practised chemistry and the person who followed the profession of pharmacy, and Continental chemists often expressed their inability to understand what they no doubt regarded as one of our many national peculiarities. For the present, the members had to be content to express the hope that their friends the pharmacists, without relinquishing their rights, would, wherever possible, refer to their ancient, important, and very honourable calling by the word which more accurately defined and described it. The power—he might say the tyranny—of a word was often very great, and he appealed to the Press, as a very important factor in the enlightenment of the general public, to assist, so far as it could, by employing the terms *chemist* and *pharmacist* respectively in the correct signification. It was to be deplored when such confusion was the unfortunate consequence of the poverty of a language; but, in this instance, the correct and distinctive words were readily available, and the confusion was therefore easily avoidable. If chemists themselves used the word without qualifying adjectives, it would be an effective stop towards establishing the proper meaning of the word.

The war had proved a very powerful factor in informing the public of the activities of the chemical profession, which occupied a position in the public esteem such as he (the president) would not have thought possible in his own life time; but every member should help to the best of his ability to consolidate the position they had gained and to keep alive in the public mind the enormous national importance of the profession. Whether we regarded chemistry as a subject of study, essential to an understanding of the world in which we lived, as an agent which had done so much to transform the life of man, as one of the most powerful factors in the creation of material wealth, or, finally as that department of natural knowledge on which our national prosperity and our national security so largely depended, its supreme importance was equally manifest.

Commenting on the production of British laboratory glassware, porcelain and fine chemicals, the president said that the view taken by the Council of the Institute and by many others who were desirous of seeing those industries firmly established in this country, was that it would be a mistake of the first magnitude to revert to the position of dependence on foreign—and possibly enemy—nations. The whole chemical industry (including those essential to successful conduct of war), the prosecution of scientific research, with all that implies, and the practical teaching of science in schools and universities, all depended upon a supply of laboratory glassware, porcelain and chemicals, adequate in quantity, suitable in quality, and reasonable in price. On national grounds, it was obviously desirable that the country should be ever directing its activities to production and to the increasing development of its internal resources. There was, moreover, the further consideration, which was much in the minds of the Council, that the establishment of these essentially chemical industries demanded the services of properly qualified chemists. The British manufacturers had made great progress under difficult circumstances, and there appeared to be no good reason why we should not be self-supporting in all the requirements of the profession.

After complimenting the Local Sections of the Institute on their activity and acknowledging the help they had given to the Council in connection with the work of the Institute, the President commented on the fact that, at a time of almost unparalleled industrial depression, less than two per cent. of the members were without employment. He thought they might draw from this the comforting inference that employers were looking more and more to science to help them in overcoming technical difficulties and in improving their manufacturing operations. He concluded his address, however, with a note of warning. Many parents still retained the impression that chemistry afforded a rapid road, if not to wealth, at least to a comfortable competence, and that it involved a less expensive course of preparation than for other professions. A keen love of the subject was essential to success; but those who were attracted to chemistry should be prepared to face a great deal of hard and often unattractive work, and to make the very real sacrifice which a professional career inevitably involved. The course of same demands upon the financial resources of parents as that for medicine and law.

The present position of the profession should inspire its members with feelings of pride and deep satisfaction, and should stimulate them to increased endeavours to raise it still higher towards that position of pre-eminence which it was surely destined to occupy.

There was scarcely a department of human activity which was not influenced more or less profoundly by the discoveries and developments of chemistry, nor was there a single individual in the community whose comfort had not been increased and whole daily life had not been made happier —or at least, more tolerable—through the beneficent operations of that science. What discoveries in chemistry the future might hold, and in what way those discoveries might still further modify the material life of man, none could say, but it was not unlikely that if any distinctive term should be applied by the historian of the future to the era on which we were now entering, he would describe it as the "Age of Chemistry."

THE ATOMIC THEORY IN 1921.

(Continued from Last Week.)

Presidential Address, Section B., S. African Association for the Advancement of Science, Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S,

When we come to the next member rubidium we find that the atomic weight is no longer twice the atomic number plus one, as it is in the case of lithium, sodium, and potassium. Rubidium ion Rb is 18Θ (48H + 48Θ 37H +)18Θ, in which the nucleus contains 10 more hydrions and electrons than would have been expected from the lower members: the nuclear charge is 37, and there are 36 external electrons, arranged counting from the inside as before, as 2, 8, 8, 18. Irving Langmuir (J. Amer, C.S., 1919, 879) suggests that the external 18 are arranged not like the internal 18 (viz., as 2, 8, 8), but by uniform distribution over a spherical surface, viz., two polar and 8 in each of two zones round the equator. This again gives a surface without projections or lacunæ, and corresponds to the inertness of the rubidium ion. Similarly Cs (cæsium ion) is 27Θ(78H + 78Θ 65H +)27Θ, with weight 133, nuclear charge 55, and 54 external electrons arranged 2, 8, 8, 8, 18, 18. The top mem-

with *external electrons arranged* 2, 8, 8, 18, 18, 32. This arrangement of the electrons in concentric layers finds its origin in Rydberg's *remarkable observation that the* atomic numbers of helium, neon, argon, krypton, xenon and niton (viz., 2, 10, 18, 36, 54 and 86), *which are also the numbers* of external electrons in the ions of lithium, sodium, potassium, rubidium, cæsium and *ekacæsium, are given by the mathematical* formula $N=2(1^2+2^2+\ ^2+3^2+3^2+4^2$ &c.), *e.g.*, 36 = 2(1 + 2 + 2 + 3) for the fourth member. This at once gives the distribution in the concentric shells as 2, 8, 8, 18, 18, 32, 32. Langmuir gives this a physical basis by noting that areas of concentric spheres of radius 1, 2, 3, 4, 5 vary in the same proportion as the numbers 2, 8, 18, 32, 50. He therefore assumes that these higher atoms have spheres of radius 1, 2, 3 and 4, and that there are two electrons in each unit of area in every sphere except the innermost, thus giving the numbers 2, 8, 8, 18, 18, 32, 32, it being assumed that each area-unit is filled *twice* over with a *single* electron, giving thus 2, 2+8, 2+8+8, 2+8+8+18, and so on, these being the numbers 2, 10, 18, 36, 54, &c., which are the total number of electrons present. This theory is so beautiful and comprehensive that it must be essentially true: at any rate it is likely to supplant the older theory that the electrons are in revolution round the nucleus like planets round a sun. Bohr *has, however, recently suggested that* 32 *is* succeeded by 18 and 8, not by 50.

The same theory, it may be noted, applies to the halogens fluorine, chlorine, bromine, and iodine. Fluoride *ion* F′ is 5Θ(10H+10Θ 9H+)5Θ, which is an "inert" structure like that of sodium ion and that of neon (= 5Θ(10H+ 10Θ 10H + 5Θ. So the chloride ion is 9Θ(18H+ 18Θ 17H +)9Θ when its atomic weight is 35.
17H +)9Θ when its atomic weight is 35.
When the atomic weight is 37* the constitution is 9Θ(20 20Θ 17H+)9Θ. Similarly argon of the atomic weight 40 (*i.e.*, out of order in the periodic table) is 9Θ (22H+22Θ 18H+)9Θ. *Bromine* ion is 18Θ(45H+ 45Θ 35H+)18Θ, krypton being 18Θ(47H+22Θ 18H+)9Θ, bromine ion is 18Θ(45H+45Θ 35H+)18Θ, krypton being 18Θ(47H+47Θ 36H+)18Θ, iodine ion is 27Θ(74H+74Θ 53H+)27Θ, xenon being 27Θ(76H+76Θ 54H+)27Θ. The theory is, however, rather unsatisfactory for carbon and all the elements below it. Carbon would be Θ(6H+ 6Θ 6H+)Θ with a residual valency of plus 4, but, as I say later *on, it is likely* that the nucleus itself is arranged like a tetrahedron (as the valencies are), whereas the above is unsym*metrical.* Similarly, helium gas would be Θ(2H 2Θ 2H)Θ, which is very unsatisfactory from its lack of symmetry. Helium *gas has in reality a round molecule*, as shown by its c_p/c_v ratio.

Again, if Rydberg's formula be examined surprise will be felt *that it does not read* N = 2 (1 +1 +2 +2 +3 +3 +4 , etc.), in which case it would be perfectly symmetrical. *Assuming* then, *this form of the* equation, the successive sums are 2, 4, 12, 20, 38, 56, 88, these being therefore the number of electrons. Helium would be *second* in this series, and have a shell of 4 electrons instead of 2. As it is neutral, one would have to assume a nucleus of 4H , with the shell of 4 electrons far out and in tetrahedral order. The nuclear charge, the number of external electrons, and the atomic number would all be the same, viz.: 4, if two elements exist between hydrogen and helium. This very neat and satisfactory proposition is, however, knocked on the head by the existence of the α-particle of radioactivity which has mass 4 and two positive charges. It changes into helium on striking any kind of matter, and is therefore regarded as helium nucleus. The only explanation of these contradictions that suggests itself to me is that of rearrangement. Helium nucleus with atomic number 2 is unsymmetrical, viz. (2H +2Θ 2H +) (see Fig. 7), but when two electrons are taken on to give helium gas, the arrangement Θ(2H 2Θ 2H)Θ changes into the conguration shown in Fig. 8.

Although there *is* experimental evidence regarding the nucleus in this case, there is *none in the case of any of the others.* Carbon nucleus as (12H++6Θ) is merely a deduction from helium nucleus (4H+ +2Θ). *If the atomic number of carbon is* 8, *not* 6, the nucleus is (12H+ +4Θ) which can be constructed as a tetrahedral model, whereas (12H+ +6Θ) cannot. In addition the *four* electrons which would then be required to make a kernel out of a nucleus could also

* See Aston, *Phil. Mag.*, 1920, 611, and my prediction, "Modern Alchemy and Transmutation," J. S. A. Association
Anal. Chemists, 18/9/17.

be arranged tetrahedrally, and finally the remaining four valency electrons would form an outer tetrahedron.

At this stage a brief *resumé* of the experimental evidence for the present-day view of the atom is necessary. The essential conception, as I have mentioned in the introduction, is that the atom is hollow consisting of a sphere, or concentric spheres. of electrons with an outer diameter of about 10 cm., and an exceedingly small nucleus (about $\frac{1}{1000}$ of the diameter of the electron sphere), which, however, contains nearly all the weight of the atom, and in the case of a heavy element a very high *positive electric charge.* *Just outside this* nucleus there is an immensely powerful *electric field, due to the action of the positive* nucleus and the sphere or spheres of electrons. This conception, which is due to Sir E. Rutherford, arose in order to explain the fact that the α-particles of radium, which are about 7,000 times as massive as electrons, and which are positively charged and travel with a speed of about 50,000 miles a second, when passed through thin metallic sheets, are deviated through large angles just as the tiny electrons can be deviated by *moderate* electric fields. The highly-deviated particles are those which have not *only* penetrated the electron-sphere of the atom, but have passed *uncommonly near to the nucleus,* and have thus been thrown into a hyperbolic orbit despite their immense velocity. It is conceived also that those which actually aim at the nucleus of a larger atom are turned back in their path.

This conception holds in its simplest form for the first 20 (or so) elements which have only *one* sphere of electrons. For the higher elements it is necessary to assume two or three concentric spheres of electrons and a bigger and more highly charged nucleus, until at the top of the series the nucleus becomes unstable owing to its excessive charge, and disintegrates automatically, giving rise to radioactivity. Since atoms are electrically neutral, the total number of external electrons in the spheres must be equal to the positive charge of the nucleus. The number of external electrons can be estimated experimentally from the scattering of X-rays, because each electron is, comparatively speaking, far apart from its neighbours, and thus acts as an independent agent. Barkla thus found by trying different elements that the number of electrons is always a little less than half the atomic weight of the scattering element. Again, calculation from the deviation of α-particles (mentioned just above) when they are passed through different metals, leads to a result for the positive charge of the nucleus amounting to the electrical unit multiplied by about half the atomic weight of the element used as a screen. These two experimental lines thus converge to the same result. Again in 1913, Moseley* a young genius who was killed in the war, applied the principle of the X-ray spectrum, which has proved very fruitful in the case of salt crystals, to the lower elements, and *discovered the remarkable law,* $N = K\lambda$. in which λ is the wavelength of the chief *X-ray line given by an element,* and *N* is a number which is a natural integer, going up by 1 as the element investigated goes up the periodic table. *N* is, in fact, an "atomic number," which depends only on the place of the element in the Periodic Table. Curiously enough, when the results are plotted, the bottom of the series is found at helium, not at hydrogen, so that *N* is not the Chemist's atomic number, but one less. It is seen at once that *N* is also about half the atomic weight, so that three *lines of evidence converge* to prove that the nuclear positive charge (and in consequence the number of external electrons) are determined in the case of each element by its position in the Periodic System, and are *numerically identical with the* "*atomic* number" as defined above.

The *Periodic Table* is thus explained away (except for its arrangement in 8 or 10 columns), since, for example, sodium metal has 11 plus charges in its nucleus and 11 electrons outside, and the next element (magnesium) has 12 of each, thus putting up its "valency" by one. Valency is, of course, as mentioned on page 1, the criterion of chemical properties, which have nothing to do directly with the nucleus of the atoms, but are solely conditioned by the external electrons, and, to speak more particularly, are almost solely conditioned by the number and arrangement of the few outermost electrons which are left over from filling the atom with a spherical shell. As already indicated on page 4, sodium is monovalent and aluminium trivalent, be-

* *Phil. Mag.*, 1913, 1,024, and 1914, 703.

cause the completed shell* of all the elements N, O, F, Ne, Na, Mg, Al contains 10 electrons, leaving respectively 1 and 3 over for valency electrons. Similarly the negative valencies 1, 2, and 3 of fluorine, oxygen and nitrogen are due to their possessing respectively 9, 8, and 7 external electrons, whereas 10 are required to make an inactive shell. of the same shape as that of neon he latter is inactive because it has 10 external electrons exactly (being the 10th element in the Periodic Table), and therefore none over or under the number required for a complete shell. The analogous cases amongst the higher elements will be discussed later on.

(To be continued.)

* The "completed shell" is, it may be repeated, the ionised form of the element.

PROCEEDINGS AND NOTICES OF SOCIETIES.

Provisional Report.

THE ROYAL SOCIETY.—*Ordinary Meeting, February 23, 1922, Sir Charles Sherrington, President, in the Chair.*—The following papers were read (*the Summaries here printed having been supplied by the authors for use at the Meeting*):—

C. D. ELLIS.—β-Ray Spectra and their Meaning. Communicated by Sir E. Rutherford, F.R.S.

A method is given for finding wave-lengths of γ-rays, which are of too high a frequency to be measured by the crystal method. This depends on the fact that γ-rays are converted into β-rays according to the quantum relation. If the energies of the groups of electrons ejected from a substance by γ-rays be measured, it is only necessary to add to these energies the work done in removing the electron from inside the atom to the surface to obtain $h\nu$. The value of this additional term may be found from observations of the energies of corresponding groups excited in different substances. This method is applied to find the wave-lengths of the γ-rays emitted by radium B, radium C, and thorium D. The radium B, radium C, and thorium D. The energies of the β-ray groups of thorium D have been measured for this purpose. It is shown that these γ-rays are emitted from the nucleus and the numerical values of the wave-lengths suggest very strongly that the quantum dynamics applies to the nucleus, and that part, at least, of the structure can be expressed in terms of stationary states. Suggestions for the energy of these stationary states in the radium B and thorium D nuclei are given.

PROF. A. E. CONRADY.—A Study of the Balance. Communicated by Mr. C. V. Boys, F.R.S.

1.—The first weighings by the Gaussian method of exchange made with an inexpensive analytical balance, stated to be sensitive to 1/5th mg., gave a probable error of only 0.004 mg., and led to a prolonged investigation with a view to reducing this error. Persistent failure eventually led to the discovery of a constructional fault in the suspensions. On removing this, the probable error fel lto 0.0013 mg. Discussion of residual errors of the series of weighings which gave this result disclosed a new systematic error, depending on the sequence of pointer readings in successive exchanges, which was attributed to imperfect elasticity and irregular curvature of knife-edges.

A method of double exchange of loads was then evolved which, by close adjustment of a light rider, caused all readings to fall on two alternating positions of rest, and eliminated the suspected source of error. The probable error fell to 0.0008 mg., and seemed now largely due to irregular air-currents. Arrangements allowing manipulation of loads without opening of balance case then reduced the probable error to an average value of 0.0004 mg., which is ½ to 1/5th that recorded for similar weighings by the great institutions for weights and measures.

2.—The principal conditions which a balance of highest precision should satisfy are deduced from a quantitative estimate of sources of error.

3.—Considerable importance is attributed to the "autostatic" state of a balance; if the centre of gravity of the moving parts falls in the supporting line of the central knife-edge, the reading of the pointer becomes independent of levelling of the balance case, and highly accurate results can be obtained on very infirm supports.

J. S. OWENS, M.D.—Suspended Impurity in the Air. Communicated by Sir Napier Shaw, F.R.S.

The paper describes an investigation, the object of which was to provide some simple and effective method for examining the quantity and nature of dust in the air and

its relation to visibility, for examination of industrial fumes, dust in mines, smoke fogs and the like. The work was carried out by the author for the Advisory Committee on Atmospheric Pollution.

A short description and criticism is given of methods now in use for the same purpose, and of the author's automatic filter and results obtained therefrom.

A new method of sampling for measurement and examination is described, in which a fine jet of air is made to strike a glass surface with high velocity, depositing the dust thereon. The evolution of the instrument is described and the final form which it has taken. Tests of efficiency are given, and also experiments showing the effect of velocity of jet on the operation of the instrument.

The adhesion of dust to the glass is discussed and a short description of possible applications given. As illustrating one application experiments are described which ndicate:—

(a) That visibility is usually a function of amount of suspended impurity.

(b) That suspended dust travels over great distances; records being described of dust which presumably must have come from the Continent.

(c) That the microscopical examination of such dust records indicates curious differences depending upon wind direction, which are at present not explained.

A table of experiments made at Holme, Norfolk, is given, and these experiments discussed.

R. V. SOUTHWELL.—On the Free Transverse Vibrations of a Uniform Circular Disc clamped at its Centre; and on the Effects of Rotation. Communicated by Prof. H. Lamb, F.R.S.

A recent paper by Prof. H. Lamb and the present author dealt with the influence of rotation upon the normal modes and frequencies of free transverse vibration in a uniform circular disc, complete freedom from constraint being assumed. Some of the modes were found to involve transverse displacement of the centre, and to make the analysis more representative of the conditions which obtain in the vibrations of turbine discs the present paper extends it to cover the effects of constrains which prevent, along a small circle concentric with the free edge, the occurrence either of finite transverse displacement w, or of finite slope $\delta w/\delta r$. The constraints are assumed to have no effect upon the centrifugal stress-system.

Section I. deals with a disc which does *not rotate. Clamping along a small circle* is found to produce only slight changes of frequency in modes characterised by two or more nodal diameters, but to be important in its effect on the "symmetrical" modes *(no nodal diameters) and on modes having* one nodal diameter, although in the latter case these effects tend to a zero limit as the radius of clamping is indefinitely reduced.

Section II. deals with the other extreme case ,in which the flexural rigidity may be neglected. Here the central constraint, whatever be the radius of clamping, is found to have no effect upon the natural frequencies.

Section III. deals with the general case, in which both flexural and centrifugal stresses require to be considered. The gravest frequencies in modes which have nodal diameters may be calculated by the formula previously given; a special investigation is made of the gravest frequency in a symmetrical mode.

A. E. OXLEY, M.A., D.Sc.—Magnetism and Atomic Structure, II.—The Constitution of the Hydrogen-Palladium System and other Similar Systems. Communicated by Prof. A. W. Porter, F.R.S.

The susceptibility of palladium black charged with hydrogen is found to be less than that of pure palladium black. From this it is concluded that the occluded hydrogen is neither in the atomic state nor condensed molecular hydrogen. The results agree with the existence of a chemical compound, probably Pd-H. The nature of this combination is discussed along lines similar to those developed for the H-H system (Proc. Roy. Soc., A., Vol. 98, 1921).

In the hydrogen molecule, each atom, on this view, thrusts its electron into the other atom, the bond heing represented by a pair of electrons held in common. The palladium atom has 46 electrons, the hydrogen atom 1 electron, the latter being thrust into the outer shell of the palladinm atom. If these 47 electrons take up a configuration like that of the silver atom (atomic number 47), which is diamagnetic, the fall of susceptibility may be accounted for.

Paramagnetic manganese fused in hydrogen becomes ferro-magnetic. It is suggested that the occluded hydrogen atoms thrust their electrons into the outer shells

of the manganese atoms, producing in them electron configurations analogous to that of the iron atom. The amount of occluded hydrogen necessary to produce the effect observed is calculated.

The cubical atom theory appears to be consistent with these conclusions, in so far as the properties of such compound systems are determined by the sharing of electrons.

T. CARLEMAN and PROF. G. H. HARDY, F.R.S. — Fourier's Series and Analytic Functions.

If $f(\lambda)$ is integrable in the interval $o, 2\pi$), and the associated function $\phi(u) = \frac{1}{2}[f(a+u)+f(a-u)]$, where $o<a<2\pi$, is harmonic and bounded in a certain neighbourhood of $u=o$, then the necessary and sufficient condition for the convergence of the Fourier series of $f(\lambda)$, at $\lambda=a$, is that $\phi(u)$ should tend to a limit when u tends to zero through positive values.

PROF. A. MCAULAY.—Multenions and Differential Invariants, II. and III. Communicated by Mr. W. B. Hardy, Sec. R.S.

Part II. is a continuation of a previous communication with the same title. The fundamental quadratic form is introduced. It is shown how all multenion formulæ may be put into invariant form. Detailed rules are developed for this purpose. Tests, both by finite and by infinitesimal transformation are given, for ascertaining whether invariance of each one of six types subsists for any given function. Riemann's and Weyl's manifolds are studied, and a detailed analysis of the general conception of curvature in the latter is given. Finally, multenion methods are compared with those of the Theory of Tensors and details furnished for translating from one mode of presentation to the other. The special applications to the case of $n=4$ and relativity have not yet been reached.

Part III. gives a rapid general survey of the applications of a Riemann manifold to relativity. In relation to matter and gravitation no new principle is introduced, but the electro-magnetic field is treated in a novel manner. The scalar and vector potentials are wholly ignored, and the subject seems to gain in clearness thereby. The application to matter in bulk is kept in mind, and it is considered imperatively necessary to adapt relativity methods to a sufficiently general set of relations as at least to leave Maxwell's explanation of crystalline reflection, refraction and transmission of light intact. The paper reaches a satisfactory point of view of these aspects.

THE CHEMICAL SOCIETY.—*Ordinary Scientific Meeting, Thursday, March 2nd, 1922, at 8p.m.*—The following papers were read:

New halogen derivatives of camphor, Part II.—$_a$'-bromocamphor. T. M. Lowry, V. Steele, and H. Burgess.

The rotatory dispersive power of organic compounds, Part X.—The preparation and properties of pure ethyl tartrate. T. M. Lowry and J. O. Cutter.

The molecular configuration of polynuclear aromatic compounds, Part I.—The resolution of γ-6:6′-dinitro- and 4:6:4′:6′-tetranitro-diphenic acids into optically active components. G. H. Christie and J. Kenner.

THE OPTICAL SOCIETY.—*Imperial College of Science and Technology, South Kensington, S.W.7.*—List of Officers and Council for 1922-23, appointed at the Annual General Meeting, held on 9th February, 1922:—

President: Sir Frank Dyson, M.A., LL.D., F.R.S., Royal Observatory, Greenwich, S.E.10.

Vice-Presidents: Prof. F. J. Cheshire, C.B.E., Imperial College South Kensington; T. Smith, B.A., National Physical Laboratory, Teddington; R. S. Whipple, 15, Creighton Avenue, Muswell Hill, N.W.10.

Treasurer: Major E. O. Henrici, R.E., 29, Royal Crescent, W.11.

Secretaries: (a) Business Secretary, Prof. Alan Pollard, Imperial College, South Kensington; (b) Papers Secretary, F. F. S. Bryson, M.B.E., M.A., B.Sc., Glass Research Association, 50, Bedford Square, W.C.1.

Librarian: J. H. Sutcliffe, M.B.E., 10, Cligord's Inn, Fleet Street, E.C.4.

Editor of Transactions: J. S. Anderson, M.A., B.Sc., Ph.D., 5, Udney Park, Teddington.

Council: J. S. Anderson, M.A., B.Sc., Ph.D., 5, Udney Park, Teddington; Instr.-Comdr. T. Y. Baker, R.N., B.A., Admiralty Research Laboratory, Teddington; L. Booth, M.A., "Delamere," Sandal, near Wakefield, Yorks.; R. W. Cheshire, B.A., 23, Carson Road, Dulwich; R. S. Clay, B.A., D.Sc., Northern Polytechnic Institute, Holloway Road, N.; J. W. French, D.Sc., Friars Crag, 20, Kirklee Road, Glasgow; W. Gamble, 109, Farringdon Road, E.C.1; Mrs. C. H. Griffiths, M.Sc., 48, Alexander Road, Wimbledon, S.W.; J. Guild, A.R.C.S., Lalbagh, Park Road, Teddington; L. C. Martin, B.Sc., A.R.C.S.,

10, Lunham Road, S.E.19; R. Mullineux Walmsley, D.Sc., Northampton Polytechnic Institute, Clerkenwell, E.C.1; Prof. A. W. Porter, D.Sc., F.R.S., University College, Gower Street, W.C.; J. Rheinberg, 23, The Avenue, Brondesbury Park, N.W.; A. Whitwell, M.A., 52, Alexandra Road, Wimbledon, S.W.19.

Professor A. A. Michelson, of the University of Chicago, and Dr. M. von Rohr, of Messrs. Carl Zeiss, Jena, were elected Honorary Fellows.

Society of Glass Technology. — The fiftieth meeting of the Society of Glass echnology was held in the College of Technology, Manchester, on February 15th, the President, Dr. M. W. Travers, F.R.S., being in the chair.

In directing the attention of members to the fact that the Society was meeting for the fiftieth time, the president said that from small beginnings at the end of 1916 the Society had steadily increased its activities and membership. The number of members now exceeded 650, drawn from various parts of the world, about one hundred being American. He hoped that when the Society celebrated its one hundredth meeting it would be able to report a continued increase in its usefulness and prosperity.

The first part of the programme at the meeting was devoted to a consideration of a paper by Mr. F. W. Hodkin, B.Sc., and Prof. W. E. S. Turner, D.Sc., entitled "The Relative Advantages and Disadvantages of Limestone, Burnt Lime, and Slaked Lime as Constituents of Common Glass Batches containing soda-ash and salt cake," Part II

In presenting this paper, Prof. Turner said it was the continuation o fa paper given at a former meeting of the Society. The conclusions were that the rates of melting depended upon a number of conditions, such as the for mof alkali and lime used, and the relative amounts of lime and soda used. In the case of glass such as that used for bottles made on automatic machines, and containing about 8 per cent. of lime, the soda-ash burnt lime batch appeared to be the most readily melted. With lime-containing glasses, the melting could be assisted considerably by the addition of small amounts of other oxides, particularly by the addition of magnesia. In the case of glasses containing about 12 per cent. of lime, the slaked lime containing batches, in general, melted most readily. A discussion followed the paper, to which there contributed Messrs. W. J. Rees, G. Simpson, A. S. Giles, and F. G. Clark. Mr. Hodkin and Prof. Turner replied

The remainder of the meeting was taken up with a discussion of the subject of "The Melting of Glass." A number of questions on the subject had been submitted by members, and formed the basis of the discussion; this being continued from the Leeds meeting in November, 1921, at the general request of members.

The questions discussed were:—

What is the objection to using a large quantity of cullet? What are the troubles it is likely to cause? If there are any, then what is the safe maximum proportion of cullet to batch?

What is the procedure to adopt in order to ascertain the homogeneity of the glass, and

(a) is it better to fill into the furnace batch and cullet separately, or batch and cullet mixed?

(b) is it better to fill into the furnace batch and cullet by the use of a crane-filling shovel through the charging door and distribute them over as great an area as possible, or through the doghouse filled by the overhead batch hopper?

For a window glass averaging 73 per cent. silica, 14 per cent. lime, 13 per cent. soda, are there different physical properties, viscosities, difficulties in handworking, due to the nature of batch, either soda-ash or saltcake? Should window glass made with soda-ash be inferior to window glass made with saltcake, or less workable in glass gathering? It would seem apparent that the use of soda-ash as constituent of the batch is more efficient as to the life of the tank blocks, and also to the clouding of the window glass cylinders reheated in the furnace flame containing sulphur from saltcake, and consequently worthy of commandation?

How long prior to working should a melt be maintained at "plaining" temperature once it is already plain?

Those contributing to the discussion were: The President, Messrs. W. R. Barker, J. H. Bickerton, Wm. Butterworth, F. G. Clark, J. Connolly, A. S. Giles, P. Haller, F. W. Hodkin, G. Simpson, V. H. Stott, Prof. W. E. S. Turner and Duncan Webb, Jun.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.—*Ordinary Meeting, 1st March*, 1922.—Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards, President, in the Chair. Papers, of which the following are abstracts, were read:—

Abstract.

"The Theobromine content of Cocao Beans and Cocoa," by Raymond V. Wadsworth.

The analyses of Cocao Beans from 21 different producing areas showed a variation in the theobromine content of the nib from 2.2 per cent. to 3.9 per cent. calculated on the dry fat-free material. The variation is due, firstly to the variety of the bean, 0the Criollo bean containing much less theobromine than the Forestero), secondly to the amount of fermentation the bean has been subjected to (fermentation reduces the theobromine considerably).

In the shell, the theobromine varies much more than in the nib. The variation found was between 0.19 per cent. and 2.89 per cent. This difference is wholly due to fermentation; during the process the alkaloid is brought by the sweatings from the nib to the shell, the amount naturally present in the shell being only 0.19 per cent.

During roasting there is practically no loss of theobromine from either nib or shell.

The analyses of 22 brands of commercial cocoas showed a variation in the theobromine content of 2.39 per cent. to 3.55 per cent. calculated on the dry fat-free cocoa.

Abstract.

"The Value of Fish Scales as a Means of Identification of the Fish used in Manufactured Products," by R. E. Essery, B.Sc., A.I.C.

The author points out that, in many cases, useful information as to the variety of fish employed in manufacture may be obtained from a microscopical study of the scales. Even in the case of fish-pastes, where the scales are largely broken up, the method possesses value. The author showed diagrams of seven types of scale.

Abstract.

"The Examination of B.B. Ointments," by Norman Evers, B.Sc., F.I.C., G. D. Elsdon, B.Sc., F.I.C.

Methods of analysis are given for the examination of certain B.P. Ointments. The Refractive Index as a method of testing ointments is discussed.

Abstract.

"The Determination of Aldehydes and Ketones by means of Hydroxylamine," by Alex. H. Bennett and F. K. Donovan.

The authors show that the method for the estimation of Citral in Lemon oil, previously described by one of them (Bennett, Analyst, 1909, 34, 14) is applicable in the case of other aldehydes, such as formaldehyde, benzaldehyde, cinnamic aldehydes, citronellal; and of ketones, such as acetone and carvone. With camphor no quantitative results could be obtained.

Slight modifications in methods of analysis which are necessary with different substances are described.

In the case of acetone, accurate results can be obtained even in the presence of ethyl alcohol. The authors consider that the estimation of citral by means of hydroxylamine is to be preferred to the method involving absorption with sodium sulphate.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

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LECTURES BEFORE EASTER, 1922. FRIDAY EVENING DISCOURSES

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

CHEMICAL NOTICES FROM FOREIGN SOURCES

VARIATION OF THE MECHANICAL PROPERTIES OF ALLOYS AND METALS AT LOW TEMPERATURES—*Léon Guillet and Jean Cournot.*—The authors have carried out a series of experiments to determine the influence of low temperatures upon the hardness and resilience of metals and alloys. The temperatures were 20° (room temperature), -20° (ice and calcium chloride), -80° (carbon dioxide snow), -190° (liquid air). The specimens were kept at the constant temperature before being tested. The results obtained showed that in general the hardness of the metal is increased by cooling. Fraglity at low temperatures is a characteristic of ferrite, the rapidity of the fall of the resilience as a function of the temperature being greater the greater the proportion of ferrite present. Nickel and copper, on the contrary, do not increase the fragility while aluminium in large quantities seems to produce a slight increase of resilience. Special perlitic nickel steels are very fragile in liquid air, but an increase in the amount of nickel present decreases the lowering of the fragility with the temperature.—(*Comptes Rendus CLXXIV.*, 1922, No. 6.)

THE OXIDES OF URANIUM—*P. LeBeau.*—Although much work has been done on the oxides of uranium, there is still a good deal of uncertainty as to the nature of some of them. The author in this paper summarises the work he has done on the subject. Uranium anhydride UO_3 can be obtained in the pure state by heating uranyl nitrate or uranic hydrate to constant weight to a temperature of 500° in a current of oxygen. When uranic anhydride is heated in air, it is unaltered up to 600°. Decomposition begins at 700°, and is rapid at 800°, when a greyish black powder is obtained, having the composition represented by the formula U_3O_8. There is no further change of weight when it is heated to 1,000°, whether it is cooled quickly or slowly. At temperatures below a red heat mixtures or more probably solid solutions of UO_3 and U_3O_8 are obtained. As the atomic weight of uranium is high, these oxides have very nearly the same percentage composition, but they behave differently towards various reagents. Thus they alter slowly in contact with damp air, and at the ordinary temperature uranic anhydride is hydrated, giving hydrated uranic acid $UO_2(OH)_2 H_2O$. When organic salts of uranyl are calcined, dark greenish black oxides are obtained, which in course of time become lighter green owing to the formation of efflorescences on their surface. These oxides probably contain variable quantities of uranic anhydride, which undergoes a change when exposed to moist air. The reduction of U_3O_8 by means of hydrogen begins at about 500°, but is not complete at that temperature, even after hours of heating. If, however, the temperature is raised to 900° to 1,000° it rapidly becomes total. No intermediate oxide appears to be formed, the brown product being UO_2. This oxide has been variously described as being black, copper coloured, or cinnamon brown, but as a matter of fact, when pure, it is always chestnut brown in colour.—(*Comptes Rendus, CLXXIV.*, 1922, No. 6.)

ACTION OF SELENIUM ON GOLD—*H. Pélabon.*—When gold which has been polished and then exposed to the action of selenium at a temperature approaching the boiling point of the latter is examined micrographically, there is clear evidence that the gold is attacked, and after such treatment it appears to fuse more easily. It dissolves in the selenium in very small quantities, or possibly the two elements form an unstable compound. On cooling, the metal is precipitated in tetrahedric crystals.

SOME NEW DERIVATIVES OF SULPHOBENZIDE—*Eng. Grandmougin.*—The author has prepared many derivatives of sulphobenzide such as the dihalogen compounds, the dinitro compound, etc., and finds that from the point of view of synthetic dyes they possess no advantages over those obtained from more conveniently obtained and cheaper bases. If it were possible to prepare a hexanitro compound by direct nitration, it might be valuable as an explosive, but by this means only a tetra nitro derivative can be prepared.

COMPOSITION OF ESSENCE OF TURPENTINE FROM ALEPPO—*Georges Dupont.*—The composition of the essence of turpentine obtained from various different kinds of trees does not depend upon the nature of the tree, nor upon the time at which the essence is obtained. The composition of fresh essence obtained from Aleppo is as follows:—

d-Pinene	95 %
Inactive Bornyl Acetate	1.14%
Sesquiterpene	3.8 %

GENERAL NOTES.

Dyestuffs Importation.—A number of questions were put in the House of Commons this week with regard to the importation of dyestuffs. Mr. Kiley asked the President of the Board of Trade whether he had approved of the action of the Dyestuff Advisory Licensing Committee in demanding from applicants for licences to import dyes highly confidential business information, such as the name of the foreign manufacturer, the purpose for which the dyes were required, and the name and address of the applicant's customer in this country; and whether the rules for the administration of the Dyes Act could be revised so as not to compel applicants to disclose confidential information to business rivals who are members of the committee?

Mr. Balfour replied that he was aware that the Dyestuffs Advisory Licensing Committee had thought it advisable, for the efficient discharge of their duties, to ask for information of the kind indicated by applicants for licences. He saw no reason for interfering with the exercise of their discretion in this matter, which, so far as he was aware, had not been a cause of complaint by users. With regard to the second part of the question, he would refer the hon. member to the provisions of Section 2. sub-section (5) of the Dyestuffs (Import Regulation) Act.

Mr. Hogge asked the President of the Board of Trade if he was aware that it was the practice of the Dyestuffs Committee, when an application was made for permission to import certain German dyes not made in this country, to advise the applicant to apply to Swiss agents for the same, and could he give any reason for such proceedings?

Mr. Balfour replied: I understand that, in accordance with the strong wish of the dye-users generally, in consequence of the assistance rendered by the Swiss dye-makers to the textile industries during the war, such advice has been given.

Mr. Raffan asked the President of the Board of Trade whether he was prepared to immediately institute an inquiry on the working of the Dyestuff Advisory Licensing Committee and to hear evidence of specific cases of injury to industries consuming dyes caused by the continual refusal of the licensing committee to grant licences for specific dyes not obtainable from home sources of supply?

Mr. Baldwin: No, sir. I have no reason to suppose that there is any serious dissatisfaction among dye-users generally with the operations of the Committee, on which the users are strongly represented, and which is discharging a very difficult task with great care and ability.

Major Barnes asked the President of the Board of Trade whether he was aware that applicants for licences to import dyes not made in the United Kingdom were continually being referred to British makers, who admitted that they did not make the exact dye required, but offered some substitute which the consumers state is quite unsuitable; and on what ground the Dyestuff Advisory Licensing Committee refused to grant import licences?

Mr. Baldwin: It is the practice of the Committee to refer applicants for import licences to British makers whenever there is *prima facie* evidence that the latter are in a position to supply dyestuffs identical with or equivalent to those to which the applications relate. If it appears, however, that the supplies offered by British makers are not suitable for a particular consumer's requirements, no licence is granted.

Mr. Galbraith asked what were the number of applications received by the dyestuffs committee for permission to import special dyes from Germany for the reason that such dyes were not procurable in England; and the number which had been granted and the number of similar applications to import dyes from Switzerland?

Mr. Baldwin said that the numbers of licence applications granted and refused could not be given without going through the files. During the year ended Dec. 31, 1921, applications to import 671,032 lbs. from Germany were granted, and applications to import 771,109 lbs. were refused. During the same period applications to import from Switzerland were allowed in respect of 1,796,754 lbs., and refused in respect of 502,579 lbs.

Dyes From Germany.—In the House of Commons on Monday, Mr. Hilton Young, Financial Secretary to the Treasury, informed Lt.-Col. Willey that the total weight of dye-stuffs received by this country from Germany by way of reparation up to Dec. 31 last was 4,070 tons, in respect of which approximately £570,000 (or £140 a ton) was credited to Germany; 2,400 tons have been sold for approximately £381,000

(after the deduction of expenses of realisation), or £228 a ton, which therefore represented the values ruling at the dates of sale.

Gas Poisoning.—In the House of Commons, Mr. Baldwin, President of the Board of Trade, informed Mr. T. P. O'Connor that, in accordance with the recommendations of the Carbon Monoxide Committee, an Order was made by the Board of Trade on Feb. 16, prohibiting the supply for domestic purposes of gas containing carbon monoxide, unless such gas possessed the distinctive pungent smell of coal gas, and the Board of Trade were carefully watching the position. There had, however, been no marked change recently in the proportion of water-gas supplied by gas undertakings.

Sir L. Worthington-Evans stated that experiments on the results of gas poisoning were being carried out at Porton, near Salisbury. The animals employed had been rabbits, rats and goats, and the total number to date were 26, 23, and 22 respectively. The experiments were of the same nature as those carried out with animals in the course of general medical research at universities, hospitals, and other recognised institutions, and they were conducted under the same statutory safeguards.

Important Notice. — Mr. H. Hugh Hughes having resigned, Mr. Victor Blagden, of Messrs. Victor Blagden & Co., Ltd., Coronation House, 4, Lloyd's Avenue, London, E.C.3, has been unanimously elected President of the British Chemical Trade Association and Chairman of the General Committee.

IMPORTANT.

Home Office, Whitehall,
3rd March, 1922.

Gentlemen,—I am directed by the Secretary of State to refer to the draft Regulations under Section 79 of the Factory and Workshop Act, 1901, to apply to manufactures and processes incidental thereto carried on in chemical works, which were issued on the 24th December, 1920. The Secretary of State has given careful consideration to the objections and suggestions submitted to him with regard to the Regulations, and as a result of conferences with representatives of the various branches of the Industry, at which the Regulations were discussed in detail, he is prepared to make certain modifications which are in corporated in the enclosed revised draf These modifications will, he hopes, mal the Regulations acceptable to all concerne and avoid the necessity of a formal inquir The revised draft is, he understand accepted by the Association of Britis Chemical Manufacturers and the variou other Employers' Organisations affected.

The principal alteration is the witl drawal of Regulations 12 to 15, which re quired provision for the welfare of tl workers to be made in all works to whic the code applies. Owing to the prevailin industrial depression, the Secretary of Stat has reluctantly agreed to the limitation fc the present of such provision to the worke employed in the processes specified i Part II. which involve special danger t health. He has also agreed not to brin into force immediately some of the prov sions which would involve structural altera tions at the works concerned.

Before the Regulations can be formall made the provisions of the Act require tha the draft Regulations shall be republishe as amended, and he accordingly gives th following formal notice:—

"That he proposes to make regulation to apply to the manufactures and processe incidental thereto carried on in chemica works in accordance with the draft, copie of which may be obtained on application t the Factory Department, Home Offic London, S.W.1, and that any objectio with respect to the draft Regulations by c on behalf of any person affected thereby must be sent to the Secretary of State with in 21 days from this date. Every suc objection must be in writing, and mus state (a) the draft Regulations or portion of draft Regulations objected to, (b) th specific grounds of objection, and (c) th omissions, additions and modification asked for." — I am, Gentlemen, You obedient servant, Malcolm Delevingne.

Department of Scientific and Indus trial Research, 16 and 18, Old Quee Street, Westminster, London, S.W.1.— The report described below has been pub lished by His Majesty's Stationery Offic for the Department of Scientific and Indus trial Research. Copies, price 25s. (by pos 26s.) may be obtained through any book seller, or direct from H.M. Stationery Offic at the following addresses:—

Imperial House, Kingsway, London

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37, Peter Street, Manchester;
1, St. Andrew's Crescent, Cardiff;
23, Forth Street, Edinburgh; or from
Eason & Son, Ltd., 40 and 41, Lower Sackville Street, Dublin.

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915-1918, No. 5.—*Manufacture of Sulphuric Acid by Contact Process.* — The fifth report has now been issued of the special series which is being published for the Department of Scientific and Industrial Research in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of the Ministry of Munitions.

The subject is dealt with under the following headings:—

Section 1. Mannheim Oleum Plant: General outline and description of plant; Pyrites store; Crusher plant; Description of Oleum plant; Operation of the plant; Plant control; Some Notes on the Working of the plant burners; Method of calculating percentage conversion and percentage composition of burner gases; Graphs for calculating percentage conversion of SO_2 to SO_3, *and percentage of* SO_2 *in burner gas.*

No. 6.—*Synthetic Phenol and Picric Acid* (Price 15/-, by post 17/6).—A special series of reports is being published for the Department of Scientific and Industrial Research in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of the Ministry of Munitions. The work recorded was done at or in connection with some of the National Factories during the war. The preparation of the necessary abstracts of information was begun by the Ministry of Munitions at the close of the war, and arrangements were afterwards made by the Department of Scientific and Industrial Research to complete them.

The following reports in this series have already been published:—

No. 1.—Recovery of Sulphuric and Nitric Acid from Acids used in the Manufacture of Explosives: Denitration and Absorption. Price 12s. 6d., by post 13s.

No. 2.—Manufacture of Trinitrotoluene (TNT) and its Intermediate Products. Price 17s. 6d., by post 18s.

No. 3.—Sulphuric Acid Concentration. Price 12s., by post 12s. 7d.

No. 4.—The Theory and Practice of Acid Mixing. Price 12s., by post 12s. 6d.

No. 5.—Manufacture of Sulphuric Acid by Contact Process. Price 25s., by post 26s.

Section 2. Grillo Oleum Plant: General outline and description of plant; Raw material; Varieties of acid produced; Description of the plant; Production of the magnesium sulphate mass; Chemical control; Sulphur dioxide losses in purification; Report on the appearance of a Grillo unit at Queen's Ferry after fifteen months' continuous work; Report on thermal values and efficiencies on a Grillo plant; Calculations involved in the design of the plant, etc.

Appendix I. Calculations used in determining the heats of dilution of different strengths of sulphuric acid.

Appendix II. Humidity o fair and allied data.

Appendix III. Feed chart for contact plant; Production chart for Grillo plant.

Owing to the cost of this volume, no copies are available for distribution by the Department of Scientific and Industrial Research.

NOTES ON BOOKS.

Confectioners' Raw Materials, their sources, modes of preparation, chemical composition, chief impurities and adulterations, their more important uses and other points of interest, by JAMES GRANT, J.P., M.S.C.Tech., F.I.S., F.C.S., Head of the Foodstuffs Department, College of Technology, Manchester. Edward Arnold & Co., Ltd., London, 1921. Price 8/6 net.

A sound, scientific work, dealing with confectioners' raw materials, it is a comparatively new departure. Hitherto what scanty literature has been available on the subject has been chiefly in the form of trade recipes and occasional notes in various journals. The author's aim has been to give a general knowledge of the scientific principles involved in the art of confectionery. The present age has been aptly termed the age of substitutes—a generalisation that has been brought home more or less forcibly to everybody during and since the war.

Although the book will be found of value to cookery teachers, the work is primarily intended for the aid of confectioners, and in the hands of an intelligent person it will

greatly help to remove rule of thumb and traditional methods of working—to the undoubted benefit of the confectionery worker. In a general introduction the fundamental principles of the chemistry of the subject are briefly stated, and in Chapter 2 alcohols and alcoholic beverages used as flavouring materials are described. Chapters on fats and carbohydrates are given, together with some illustrations, not only of apparatus employed in various processes, but also some extremely good photo-micrographs of wheat, barley, rye and maize starches. Other pictures of maize corn, rice berries and the maize plant are reproduced. Photographs are also given of sugar cane plantations and similar subjects.

In a chapter on eggs and egg productions it is stated that during the war South Africa exported great quantities of ostrich eggs for confectionery uses. Various methods are given for the preservation of eggs, and it is pointed out that no satisfactory egg substitutes have been obtained, the so-called egg powders consisting of some protein body coloured with turmeric or some other dye.

In a chapter on colour and colouring matters, a very brief account is given of the theory of light. This is of necessity brief, but what statements are made are those of fundamental importance. In this chapter a prescription is given for the preparation of carmine from cochineal, which we hope does not enter very largely into the preparations of the confectioner.

In a chapter on some general methods of using raw materials some short recipes are given, and the causes of some of the faults in cake-making are explained. A final chapter on the analysis of raw materials is likely to be outside the scope of the practical confectioner, but will be of considerable value to teachers and instructors. The book con-
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the Industry, at which the Regulation...ted
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facture of alloys, steels, ceramics, glass, &c. The first two chapters deal with the measurement of temperatures and the construction of mercury thermometers. Chapter 3 deals with electrical thermometers and pyrometers, and full descriptions with diagrams and other illustrations are given of most of the instruments that are used at the present day.

Chapter 4 treats of radiation, optical and other forms of pyrometers, and a special chapter is devoted to the calibration of thermometers for use above the boiling point of water. The final chapter gives a full description of the present day methods of measuring rapidly fluctuating temperatures, a matter of very considerable interest to engineers. This section is very fully illustrated by pictures and diagrams of the very latest devices used in these intricate and important estimations.

At the end of the book some data are given of standard boiling and melting points and other useful matter.

An Introduction to the Analytical Chemistry of the Rarer Elements, by LOUIS J. CURTMAN, Assistant Professor of Chemistry, Chief of the Division of Qualitative Analysis. New York, 1922.

In this modest little book of some 64 pages, the author has given a large amount of analytical data that have resulted from laboratory practice. He states that every experiment described has been personally carried out by himself. The somewhat wide title of the Rarer Elements includes the metals of the Platinum group, Gold, Thallium, Selenium, &c., as well as those elements included in the special designation of Rare Earths.

Recognising the objection to including experiments on the rarer elements in a laboratory course, on the ground of their expense, the experiments described are made with very small though definite quantities of materials.

The book deals only with the chemical reactions of the elements, no other information being given, and we cannot help thinking that the general student will find great difficulty in obtaining some of the materials described. In the case of the rare earth metal Erbium it is stated that a precipitated oxalate of it has a light rose colour. This colour could only be visible when dealing with very pure materials, which are unquestionably very difficult to obtain. Th

reactions of yttrium and erbium alone are given of those elements included in the yttria earth series. The remainder, among which we notice the author has put Scandium, are mentioned only by name.

The author, in his preface, states that the book may be used to complete a one year's course in qualitative analysis, or as an introductory textbook in a special course on the rarer elements. It undoubtedly contains a very valuable number of reactions that can be easily carried out by a student, and under the direction of a fully qualified teacher will be found of great value as a first step into one of the most fascinating fields of chemical research.

The Physical Properties of Colloidal Solutions, by E. F. BURTON, B.A. Cantab, Ph.D. Toronto. 2nd Edition with 18 illustrations, 213 pp. Price 12/6 net. Longmans, Green & Co., London. Monographs on Physics Series, edited by Sir J. J. Thomson, O.M., F.R.S., and Frank Horton, Sc.D.

The author states in his preface that this second edition is a thorough revision of the first. The important part that colloids and colloidal solutions play in natural economy is becoming recognised in every branch of scientific activity, and this second edition of the author's valuable treatise will be welcomed by every one. The work is very fully illustrated, and full references are given for statements made. Some remarkable diagrams are furnished of the oscillations of particles of various sizes and in various solutions, and Svedeberg's researches on the Brownian movements are given in detail. The book contains a mass of information upon the subject in all its branches, and in a short, concluding chapter it gives a few practical applications of the study of colloidal solutions. We cannot help thinking that this section could be greatly extended. The practical applications following the knowledge of colloids are increasing daily, and it will probably not be very long before we may welcome the third

BOOKS RECEIVED.

"Colloid Chemistry of the Proteins," Prof. Dr. Wolfgang Pauli, translated by P. C. L. Thorne, M.A. (Cantab), A.I.C. Pages: xi.-140. Messrs. J. & A. Churchill, 7, Great Marlborough Street, London, W., 1922. Price: 8/6 net.

"Isotopes," F. W. Aston, M.A., A.I.C., F.R.S. Pages: viii.-152. Messrs. Edward Arnold & Co., 41 & 43, Maddox Street, London, W.1., 1922. Price 9/- net.

"The Elements of Fractional Distillation," Clark Shove Robinson. Pages: ix.-205. Messrs. McGraw Hill Publishing Co., Ltd., 6 & 8 Bouverie Street, E.C.4. First Edition, 1922. Price: 12/6 net.

"A Concise History of Chemistry," T. P. Hilditch, D.Sc. (Lond.), F.I.C. Pages: xi.-276. Messrs. Methuen & Co., Ltd., 36, Essex Street, W.C. Second Edition, Revised, 1922. Price: 6/-.

"A Comprehensive Treatise on Inorganic & Theoretical Chemistry," J. W. Mellor, D.Sc. Pages: Two Volumes, Vol. 1, xvi.-1,065 Pages; Vol. 2, viii.-894. Messrs. Longmans, Green & Co., 39, Paternoster Row, London, E.C.4, 1922. Price: £3 3s. each, net.

New Patents.

THIS list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

3962—E. E. Dutt.—Process for extraction of titanium dioxide and vanadium salts from bauxite. Feb. 10th.

3963—E. E. Dutt.—Process for extraction of uranium and radium compounds from bauxite. Feb. 10th.

3626 A. F. Maclaren.—Treatment of sulphide pres. Feb. 7th.

3745—R. Sallmann.—Manufacture of chromium compounds of azo dye-stuffs. Feb. 8th.

Specifications Published this Week.

153254—L'Air Liquide, Soc Anon, Pour l'Étude et l'Exploitation des Procedes G. Claude Catalytic materials adapted for use in the synthesis of ammonia.

174554—W. Carpmael.—Process for manufacture of hydroquinone.

174555—H. Mayers and Britons, Ltd.—Furnaces

Abstract Published this Week.

Extracting Metals; Sodium Salts.—Patent No. 173337.—A process of extracting metals has been invented by Mr. E. E. Naef, 116, Loughborough *Road, West Bridgford, Nottingham, in which* finely-divided sulphides of lead, bismuth, silver, mercury, cobalt, or iron, or compounds of cobalt with arsenic, or with sulphur and arsenic, are heated with solid caustic soda or with a mixture of caustic soda and sodium carbonate, common salt, sodium sulphate, sodium sulphide or hydrosulphide, calcium carbonate, or lime, in the presence of hydrogen or gases containing hydrogen, and with or without the addition of powdered coal. In the case of cobalt, the presence of hydrogen *may be dispensed with. Sulphides, hydrosul*phides, thiosulphates, and arsenic compounds of sodium are formed, and the metals are precipitated. The molten salts may be poured off or the whole mass may be treated with water to dissolve the salts.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward, post free, for the official price of 1s. each.

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THE MINISTRY OF AGRICULTURE AND FISHERIES has for disposal, and invites tenders for the purchase of, the contents *of an analytical and chemical laboratory*, including reagents used in connection with research work at the Rats Research Laboratory, Mount Pleasant, London, E.C.1. There is also a quantity of factory apparatus used for the manufacture of rat bait.

A list of the articles for disposal will be *supplied upon application to the* Disposal Officer, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Application for permission to inspect the apparatus should be made direct to the Research Chemist at the Laboratory. (Telephone: City 181).

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

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12 APR 1922

THE CHEMICAL NEWS,
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ANNUAL MEETING—BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION.

HELD AT QUEEN HOTEL, BIRMINGHAM, MARCH, 1922.—Progress in non-ferrous metals research was revealed at the second annual meeting of the British Non-Ferrous Metals Research Association, held at Birmingham on March 3rd, after luncheon at the Queen's Hotel. Mr. T. Bolton, who presided, comprehensively surveyed the actibities and progress of the Association, which has now over 100 member firfs. A number of important investigations are being conducted by the Association in various laboratories. He emphasised the fact that division of labour is as important among brain workers as among hand workers, and co-operative research was the best and most economical method. He referred particularly to the proposal of the Association to establish University Fellowships for post-graduate research.

Vice-Admiral Sir George Goodwin urged the Association to make its work more widely known, and stated that marine engineers and shipbuilders woul dbe prepared to listen to proposals for memhership if the Association's programme were put before them. The scientific metallurgist, the manufacturer, and the user should have their knowledge and experience combined for the benefit of themselves and the nation.

Dr. W. Rosenhain, F.R.S., of the National Physical Laboratory, illustrated the fact that solutions to many non-ferrous problems cannot be found because present knowledge is insufficient. To make good this deficiency both men and money were required. The conduct of research through a Research Association was particularly desirable, because it formed a channel through which research could be applied.

Sir Henry Fowler, Chief Mechanical Engineer to the Midland Railway, emphasised the importance of research to users of non-ferrous metals, and trusted that the railway companies would soon be in a position to support such work. Lack of co-operation meant a loss of brains which could ill be spared. Users could help the Association as members by testing materials under service conditions.

A tribute was then paid to the work of the Chairman of the Association, and emphasised the fact that research should preferably be handed over to specialists. In the factory it was frequently neglected for other pressing work.

Sir Frank Heath, Secretary of the Scientific and Industrial Research Department, congratulated the Association on the extraordinary way in which its membership and activities had e panded during the previous year. He gave several illustrations to show the value of co-operations between user and producer. He thought the provision of an intelligence service was one of the most valuable things an Association could do, he was also particularly interested in the projected establishment of research studentships, and offered the assistance of his Department in working out a scheme. The growing appreciation of the value of research was indicated by the absence of any reference to his Department in the proposals made by the Geddes Committee.

Sir Richard Threlfall urged members not to be impatient for results. The results of research might not he merely deferred, but might not be realised at all. Some research could be done for money and business conness conditions applied to it, but for other investigations this did not apply.

After a vote of thanks to the Chairman a most successful meeting terminated.

THE ATOMIC THEORY IN 1921.

(Continued from Last Week.)

Presidential Address, Section B., S. African Association for the Advancement of Science, Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S,

DISINTEGRATION EXPERIMENTS.—It has been stated above that the particle which hits a heavy nucleus full-on is reflected back. This is not the case, however, when the nucleus in question is small. In that case the nucleus is carried on in front o the impinging particle, and the atom is thu disintegrated. The simplest case is that o hydrogen gas or of organic compounds con taining much hydrogen, e.g., wax: whe these are bombarded with α particles hydrogen nuclei (i.e., hydrions) are ex pelled. They are recognised by travellin far further than the α particles themselve can travel against a resistance. The weight is 1 with a positive charge 1: the initial velocity is 3·4 times that of th α particle. Their diameter is said to b

about 3 x 10^{-13} cm., that of the α particle being about 5 x 10^{-13} cm. Now Rutherford, 2 or 3 years ago, made the astonishing discovery that the same kind of particle could be obtained by bombarding nitrogen gas or certain solid compounds of nitrogen with particles. We conclude that they came from the nucleus of the nitrogen atom, which thus contains hydrogen nuclei, in a sufficiently separate form for them to be capable of receiving a direct impact from an particle. Check experiments with CO_2 and O_2 as gases, and with silica and graphite as solids, gave negative results. A mixture of 7½ per cent. hydrogen gas with 92½ per cent. CO_2 or oxygen behaved towards the particle exactly like nitrogen gas, giving the same number and intensity of "hydrogen particles." By means of magnetic deviation they were shown to have mass 1 and charge 1. The infrequency of the direct impact required to generate "hydrogen particles" is shown by Rutherford's estimate that only one in 300,000 of the particles hits in the required way. Of the other elements tried, boron, fluorine, phosphorus, sodium, and aluminium were also found to contain removabe hydrogen, but Li, Be, C, O, Mg, Si, S, gave negative results. It is probable, however, that all the elements are made of hydrogen, but contain it in the form of local condensations of hydrion and electrons, which are themselves so stable that they do not break up on impact with an particle; there are two of these, viz., H_3 ++ and H_4 ++ .

Rutherford's discovery of the disintegration of nitrogen was so important that he had to publish it at once without waiting to ascertain what the rest of the nitrogen atom was made of. He therefore announced that the atomic weight 14 belonging to nitrogen probably consisted of two hydrogen atoms combined with three helium atoms. On continuing his experiments, however, he soon found that the hydrogen particles were accompanied by another set of characteristic particles 5 to 10 times as many in number which differed from any previously known. From the range and magnetic deviation they were shown to possess mass 3 and charge 2, and thus to be similar to the particle with only ¾ of the latter's mass. Nitrogen of mass 14 was thus inferred to consist of 4 particles of mass 3 instead of 3 particles of mass 4, in addition to the two hydrogen nuclei. Rutherford gives the following diagram:—

3 3
⊖H⊖H⊖
3 3

but expressly states that the arrangement is arbitrary.

Since carbon and oxygen give no hydrogen particles, Rutherford infers that carbon is 3⊖3 and oxygen is 3 3 the three
3⊖3 ⊖He⊖
3 3

elements N, C, and O thus being depicted as having in their nuclei an excess of plus charges, which is 7, 6 and 8 respectively, agreeing with their atomic numbers. As explained above, the 3++ and He ++ particles are not capable of being disintegrated.

I am immensely interested in these conclusions, for some of you may remember that many years ago, long before the conception of a nucleus for the atoms arose, I predicted* that nitrogen would be found to be CX in which X is an unknown element of atomic weight 2. This prediction was made on purely chemical grounds, such as the relation of pyridine to benzene (see Fig. 5).

I also predicted that carbon would be found to consist of a tetrahedral arrangement of 4 sub-atoms of weight 3, and that oxygen is CX_2. This paper gave rise to an active discussion, hingeing mainly on the isomerisms which would be postulated by such a theory. Thus nitrogen gas and CO gas would be isomeric, both being C_2X_2. The extraordinary physical resemblance of these two gases has been recently dealt with by Langmuir.

On Rutherford's modification of my theory, the two gases are no longer isomeric but metameric, because the nuclei differ in weight, but in all other particulars of their constitution they are essentially the same, as will be seen later on.

There appears to be some chance that the element of atomi cweight 3 from nitrogen, which I ventured to call *zoicon*, will be found in minerals. After it has lost its positive charges by hitting electrons, the 3 particle (see Fig. 6) must become an inert gas closely resembling helium and possessing a spectrum similar to that of helium with a displacement. This is on the assumption that the inert gas will have

* "Some suggestions for a new atomic theory." Journ. Chem. Metall. and Min. Soc., S.A., April, 1909, page.335, also September, 1909, page 98.

two external electrons just as helium gas has. If, however, it has one electron inside, and another *outside, this deduction* would not hold, and it would become possible that the new gas is the nebulium of the nebulæ, with the constitution (Θ3)Θ and a spectrum more like that of hydrogen than that of helium. The 3++ *particle* **is** itself probably complex. viz., H+ H+, and

Θ

H+

the α particle (helium-nucleus) 4++ is *similar (see* **Fig.** *7.)*

As regards the monovalent element X=2 which I predicted in 1909, Rutherford's discovery seems to indicate that it only exists in nuclei, and that it is constituted *H+ Θ H+ (see Fig. 5), so that it yields* H+ on impact*. This means that the α particle is composed of two of these X elements, and the 3++ particle is composed of one X and one hydrion +. The stability *possessed by 3++ and 4++ is, in my* opinion, due to the symmetrical (viz., triangular and tetrahedral) arrangement developed in them when they are made up from H+ + X and X + X. In this way Rutherford's conception of oxygen nucleus as CHe becomes the same as my conception of it as CX_2.

To complete this series it may be mentione that boron appears undoubtedly to be nitrogen minus 3++, viz.,

3Θ3

ΘHHΘ

3

In connection with this subatom X+, I am very pleased also to find that Prof. Harkins, another pioneer of atomic structure, has now come to the conclusion that it is "the primary group in atom building"**, *and agrees with me that the* particle is X_2. Harkins, by the way, writes X+ as p_2 e, but his *p* is the same as my notation H+, and his *e* is the electron, so that p_2 e becomes (H+ Θ H+), which is my conception of X+. It is unfortunate that different scientific writers shoul duse different terms for the same entity, and I suggest that H+ *should always be called hydrion,* not hydrogen-nucleus or proton or H-particle. X+ should also have a name, since "isotopic hydrogen" is unsatisfactory: possibly the name *aerion* would do. Harkins uses the *very suitable name neutron for the nuclear* combination (H+ Θ), which is required according to Rutherford and himself to account for the existence of the elements whose atomic weight is greater than twice *their atomic number see rubidium p. 5).* Thus chlorine nucleus of at. wt. 35 is X *N*, in which *N* stands for one neutron, and 17 is the atomic number. Aston's Chlorine-nucleus of at. wt. 37 is then X N_3.

Assuming, then, the sub-atom X+ (=H+ Θ H+), an extraordinary connection between the inert gases and the saturated hydrocarbons can be demonstrated. CX_4 *adds up to 20 and corresponds to neon.* C_2X adds up to 36 and corresponds to the lower isotope of argon, with the constitution CX_3CX_3. Again $C(CX_3)_4 = C_5X_{12}$ (of tertiary butane) adds up to 84 and agrees with the *nucleus of Krypton, and has also* the required round shape. Similarly C X adds to 132, which agrees with xenon, and $C_{14}X_3$ adds to 228, which may be the highest isotope of niton. Adding three particles to this *niton gives* U=240. The highest possible element would then be C X =276=$C[C(CX_3)_3]_4$. Some extra binding-electrons are required to give the correct atomic numbers. This kind of formulation puts all the X's *to the outside of* the nucleus, and thus explains radioactivity. as the X's get crowded together on the surface of the nuclei of the higher elements, and are thrown off in pairs, X_2 being the particle. *It is thus the accumulation of* X rather than that of positive charge which causes radioactivity.

To repeat, the contention I wish to make is that the physicists, as far as I understand them, have placed too much emphasis on the fact that chemical properties depend on the valency electrons, and have not considered the possibility that the arrangement of valencies in CH_4 and NH_4 connotes a *tetrahedral nucleus* for C and N.

(To be continued.)

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* He says (Bakerian Lecture), "It seems very likely that the electron can also bind two nuclei . . . ." This entails the possible existence of an atom of mass 2 carrying one charge, an isotope of hydrogen, i.e., monovalent.

* I predicted this also in 1909.

** *Nature*, 1921, p. 203.

PROCEEDINGS AND NOTICES OF SOCIETIES.

Provisional Report.

THE ROYAL SOCIETY.

ORDINARY MEETING, MARCH 2, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read (the Summaries here printed having been supplied by the authors for use at the Meeting):—

PROF. L. N. G. FILON, *F.R.S.*, and H. T. JESSOP. On the Stress-Optical Effect in Transparent Solids strained beyond the Elastic Limit.

The paper describes an investigation of the stress-optical ecect in glass and cellnloid at ordinary temperatures, dealing more particularly with the time-effect in artificial double-refraction in celluloid.

The authors find that the stress-optical effect in glass under simple pressure exhibits no time-ecect at ordinary temperatures. In celluloid under simple tension, on the other hand, there is a marked creep in both stress-optical effect and strain even under very moderate loads.

The strain *s*, and the relative retardation *r*, of a specimen under constant load are found to bear a relation to the time *t*, after loading, which is fitted very well by formulæ

$$s=s_0+at+bt \qquad r=r_0+pt+qt.$$

The relative retardation and simultaneous strain on loading with a load T are found to be connected by a linear relation

$$r=\alpha T+\beta s.$$

On removing the load, the residual retardation *and strain are connected* by the law

$$r=\beta s.$$

A theory is worked out which satisfactorily explains this law, on the assumption that celluloid consists of a mixture of two constituents having different elastic and plastic properties and different stress-optical coefficients, the optical-effect in each, however, being strictly proportional to the stress.

W. E. CURTIS. The Structure of the Band Sectrum of Helium. Communicated by Prof. W. H. Hicks, F.R.S.

Grating photographs of three of the principal helium bands have been measured and analysed, with the following results:—

(1) Tables showing wave-lengths, intensities, wave-numbers and allocation to series are given, also diagrams exhibiting the structure of the bands.

(2) The chief features of their structure are shown to be accounted for by the quantum theory of band spectra, a brief résumé of which is given.

(3) In each of the three bands a new type of series is found which, although closely related to the others, has not yet received a theoretical explanation. Other departures from the theory are also noted.

(4) It is concluded that the spectrum is due to an unstable helium molecule, having a moment of inertia of about 1.8 x 10 gm.cm. .

S. DATTA. The Spectrum of Beryllium Fluoride. Communicated by Prof. A. Fowler, F.R.S.

The spectrum of beryllium fluoride, hitherto unrecorded, has been investigated. It has been found to consist of six groups of bands, all in the ultra-violet between λ 2800 and λ 3400, and all fading off towards the red.

The strongest band at λ 3009 has been investigated in detail, and has been found to include three series of lines, which depart considerably from the usual type of formula.

The *groups of bands have been found to* be similar to one of the groups of magnesium fluoride, and are related to this group in accordance with the formula for alkaline earth fluorides proposed in a previous paper.

W. G. PALMER. The Catalytic Activity *of Copper.—Part III. Communicated by* Sir W. Pope, F.R.S.

The present communication is a continuation of previous work on the same subject ('Roy. Soc. Proc.', A 98, 13, A 99, 412), and describes the effect upon the catalytic (dehydrogenating) activity of copper of adding to the metal varying proportions of oxides that are, themselves, weak dehydrogenating catalysts Ferric, manganous, zinc and magnesium oxides were used. Of these, magnesium and manganous oxides enhance the activity of the copper, if present in quantity greater than 1 to 2 per cent., while zinc, and especially ferric oxides, reduce the activity.

A simple theory of catalytic "promoters" is advanced: Small proportions of oxide (less than 1 to 2 per cent.) in general destroy the activity of the copper, presumably owing to solution in the metal leading to diminished adsorption of the alcohol reacted upon.

A new mode of preparing mixed catalytic material is described.

G. B. JEFFERY, D.Sc. (1) The Motion of Ellipsoial Particles Immersed in a Viscous Fluid. (2) The Rotation of two

Circular Cylinders in a Viscous Fluid. Communicated by Prof. L. N. G. Filon, F.R.S.

(1) Einstein has shown that the viscosity of a fluid containing solid spherical particles in suspension is given by μ (1+2.5 V), where μ is the viscosity of the pure fluid and V is the total volume of the particles per unit volume of the suspension.

This result is extended to ellipsoidal particles, and it is shown that the factor 2.5 is *reduced* by an amount depending upon the shape of the particles, but that it always lies between 2 and 2.5.

An investigation is made of the motion of the particles with regard to the surrounding duid, and also of the elastic stresses and deformations to which they are subjected by the fluid pressures on their surfaces.

(2) Two problems in the two-dimensional slow motion of a viscous fluid are discussed:—(1) the rotation of a circular cylinder in a fluid contained in a non-concentric cylindrical vessel which may itself rotate about its axis; (2) the rotation of two parallel cylinders in an infinite fluid. It is found that (1) may be solved in finite terms, while (2) is in general insoluble. that is to say, there is no steady motion for which the fluid is at rest at infinity. This result is analogous to that obtained by Stokes for the translation o fa single circular cylinder in an infinite fluid.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY, MARCH 16TH, 1922, AT 8 P.M.—The following papers were read:—

Change of properties of Substances on Drying.—H. P. BAKER.

The influence o fnitro-groups on the reactivity of substituents in the benzene nucleus. Part VI. The elimination of halogen during the reduction of halogenated nitro-compounds. — H. B. BURTON and J. KENNER.

ROYAL INSTITUTION.—A General Meeting of the members of the Royal Institution was held on the 6th inst., Sir James Crichton-Browne, Treasurer and Vice-President, in the chair. Miss A. Bagot, Mr. W. V. Ball, Miss E. J. Blunt, Mr. S. B. Donkin, Mr. R. E. Gibbs, Mr. G. N. E. Hall-Say, Mr. H. A. Hankey, Miss A. M. Herron, Mr. D. Lucas, Sir Murdoch Macdonald, Mrs. Aylmer Lloyd, Mrs. Reginald McKenna, Mr. H. B. Moberly, Mr. G. S. Odling-Smee, Mrs. W. Carpenter Scott, Mr. H. Seligman, Mrs. Sharman-Crawford, Professor G. Elliott Smith, Dr. A. Stanley, Mr. C. F. M. West, and Mr. E. Yatman were elected members. On Thursday, March 16, at three o'clock, Dr. P. Chalmers Mitchell began a course of two Lectures at the Royal Institution, on "The Cinema as a Zoological Method." The Friday Evening Discourse on March 17 will be delivered by Professor A. P. Laurie, on "The Pigments and Mediums of Old Masters," and on March 24, by Professor F. G. Donnan, on "Auxiliary International Languages."

THE SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

At a Meeting of the Manchester Section o fthe Society of Chemical Industry, held on March 3rd, Dr. E. Ardern presiding, a Paper entitled "The Inorganic Constituents of Coal, with especial reference to Lancashire Seams," by F. S. Sinnatt, M.B.E., M.Sc.Tech., F.I.C., etc., and M. Simpkin, M.Sc.Tech., A.I.C., was read hy Captain Sinnatt.

The authors of the paper stated that the investikation of the inorganic constituents of Lancashire coals was being continued, and the present paper is concerned with the examination of the modes of occurrence of iron in certain of the coal seams. The work had been carried out under the auspices of the Lancashire and Cheshire Coal Research Association.

In a paper previously read before the Section by Messrs. Bayley, Grounds and Sinnatt, it was shown that the plates of inorganic material (ankerites' found in coal seams were derivatives of calcium carbonate, in which a proportion of the base was replaced by iron (ferrous), magnesium and manganese. It is known that the ankerites undergo oxidation on exposure to air, and that this phenomenon is a factor influencing the disintegration of the masses of coal during storage.

It was suggested in the previous paper, and by several speakers in the discussion which followed its reading, that the ferrous iron and manganese might be of importance as agents leading to the spontaneous heating of coal, whether in the goaf or during storage. The present results, it is thought, may have a bearing upon the behaviour of

the ash found when the coals are burned, and may be of value in furthering the discussion upon the influence of the oxidation of the iron present upon the incipient heating of coal.

The work mentioned in the paper largely followed the lines described by Powell, except that additions can now be made to the number of types of iron that he differentiates. Powell distinguishes four forms of iron as occurring in the coal substance, and submits figures for the iron occurring as water soluble iron, iron soluble in hydrochloric acid, iron occurring as pyrites, and that present in the form of silicate. In the portion soluble in hydrochloric acid he made no attempt to differentiate between the iron occurring in the form of ankerites and that present in the mass of the coal in other combination. The amount of iron occurring in the for mo fankerites in certain specimens of coal is by no means negligible; one sample examined, in which 4.2 per cent. of ash was present, being found to contain approximately 1.7 per cent. derived from ankerites.

The subject of the different types of iron pyrites is at present being exhaustively investigated microscopically by Mr. J. Lomax, of Bolton, who has already described a number of distinct forms.

The analytical values of three specimens of pyrites were then stated, with a view to showing that their composition is variable, and that, in addition to iron pyrites, they may contain iron in the form of carbonate.

The extraction of iron by water was of some interest in connection with the water in mines. This water contains the iron in the ferrous condition, and in a recent heating which occurred in one of the pits observed by the authors of the paper large crystals were found in one of the masses of coal when the heated zone had been cooled, which, on examination, proved to be practically pure ferrous sulphate.

Iron occurring in the white partings, or ankerites, will readily pass into solution on treatment with acid, but, in view of the fact that many specimens of pyrites which occur in coal contain iron in the form of ferrous carbonate, it is clear that there are at least two sources from which the iron soluble in hydrochloric acid may be derived. Attempts had been made to determine the percentage of ankerites in coal, but without success.

The third part of the examination conducted by the authors of the paper con- sulphide present in the samples by the method suggested by Powell. The details of the experiment having been mentioned, Capt. Sinnatt stated that the residual coal was dried and ignited, and the ash carefully examined. It was found that the ash from the majority of the coals left a residue which was entirely free from iron. These prove conclusively that nitric acid completely extracted the whole of the iron from the coal. The results confirmed those of Powell.

Iron in coal may occur in at least five distinct forms, namely, in the ankerites, in ferrous carvonate, soluble iron salts, silicate, and as pyrites.

Aesults of an investigation of the temperature of decomposition of ankerites were stated in detail.

A discussion followed, in which Messrs. Grounds, Terry, Drummond, Paton, and Sannay took part, and to which Capt. Sinnatt replied.

"A Note on the Cause of Splitting of a Pottery Material."

By Mrs. M. B. Craven, M.Sc.Tech., A.I.C.

In the above-titled Paper, Mrs. Craven described the results of an investigation carried on by her during the war period, with the object of developing an English ring support for the purpose of carrting incandescent mantles. It had not always been found possible to make English earthenware ring supports for incandescent mantles which would withstand the action of heat as well as would those of certain German manufacture. When heated suddenly, the English ones "split off" or splintered. Chemical analysis did not reveal any difference which would account for the success of the one body and the failure of the other. The English clay ring supports split off at the very beginning when the mantle fabric was impregnated with the incandescent oxides, the damage being so great that quite 50 per cent. of the mantles had to be rejected, the remaining 50 per cent., which were good, having to carry the cost of the rejects. Two samples of English clay ring supports were examined, one being of better quality than the other, and also a sample of German manufacture. The investigation was rendered somewhat complicated owing to the fact that stress was laid on the difference probably being one of chemical composition. The German ring

In order to ascertain whether magnesia was present in the Yerman body a porosity test was undertaken. If magnesium carbonate had been used, then the body would be more porous than ordinary earthenware, and would probably prove to be efficient under the effects of expansion and contraction.

The analysis indicated quite an ordinary body. The inferior English body was slightly higher in alumina content than the German, while the better type of English body was approximately the same as the German. here was no bone ash content. The evidence obtained by the chemical analysis was entirely negative. There was not sufficient difference to account for the success of the German body and the failure of the English one. The German body had a porosity of 12.6, the inferior English 12.7, and the fairly good English body was slightly more dense.

The difference was discovered to be purely physical. Merely by the eye an examination of fractures of the three rings showed considerable differences in appearance. The German body broke with quite a beautiful fracture, without striation, the inferior English body exhibited considerable striations, while the moderately good English body was something like the German one. In the case of the German body the grains were quite even in size, while with the inferior English body the grains were very uneven in size. Microscopic investigations showed that the German body was somewhat badly marked with iron specks, but these did not appear to detract in any form the effective service of the ring. The inferior English body showed air spaces, veins, and striations running throughout the mass, and also little hillocks of material obviously under different stresses. The difference of formation as compared with the German was very marked.

The defect was, therefore, proved to be a mechanical one, due entirely to the lack of proper preparation of the English material. Probably flint had been used in the manufacture of the English body for the purpose of aiding silica. Flint was a very difficult material to use unless ground over a Derbyshire Chert bed. The Germans probably obtained a perfectly even texture by the use of kieselguhr, and through there being no defect with the die. The English die was not perfect. The striations were altogether due to bad pressing. The remedy appeared to be the substitution of kieselmaterials used, and better pressing, or, to sum it up quite shortly, better potting.

A number of microphotographs were exhibited by Mrs. Craven.

A long discussion took place, in which Messrs. Ardern, Terry, Drummond Paton, Huebner, and Callan took part, and to which Mrs. Craven replied.

Miss Robinson proposed, and Dr. Henderson seconded, a vote of thanks to Mrs. Craven for her paper.

(1) "The Action of Iodine upon Cellulose, Silk, and Wool," by J. Huebner, M.Sc.Tech., F.I.C., and J. N. Sinha, B.Sc.Tech., B.Sc. (Cal.)

(2) "The Ebect of Water and of certain Organic Salts upon Celluloses," by J. Huebner, M.Sc.Tech., F.I.C., and Frederick Kaye, A.R.C.S.

The Authors of the above Papers described them as preliminary notes, and stated that they had discovered that appreciable quantities of pure iodoform are produced by the action of iodine and caustic soda uponhighly purified cotton, celluloses made from different kinds of wool, natural silk, some of the artificial silks, wool, rubber, and other substances.

Samples of iodoform which have been actually made from cotton and from other celluloses were submitted for inspection.

In the second note, Mr. Huebner described some of the results of an investigation, carried out jointly with Mr. F. Kaye, on the effect of water on certain organic salts upon celluloses. In this the authors showed that pure cotton and other celluloses, when exposed to water or water vapour for a considerable time, are attacked, and that as a result aldehydic bodies are formed. Aldehydes in quite appreciable quantities are produced when pure cotton is steeped in an aqueous solution of sodium acetate and kept in an incubator for some time.

A discussion followed, in which Messrs. Higgins. Fargher, and Ardern took part, and to which Mr. Huebner replied.

GEOLOGICAL SOCIETY OF LONDON.

PRESENTATION OF MEDALS.

ANNUAL GENERAL MEETING, FEBRUARY 17TH, 1922.—*Mr. R. D. Oldham, F.R.S., President, in the Chair.*

After the presentation of the Reports, the President presented the Wollaston Medal to Dr. Alfred Harker, F.R.S., addressing

Dr. HARKER,—

From the first you have recognised, as you were among the first to realise, the necessity of combining field work with laboratory research. Well qualified by your mathematical training to apply the laws of crystal optics and physical chemistry to petrological problems, your early work on the Bala volcanic series, the Shap granite, and Carrock Fell established your position as a petrologist and field geologist. Selected to the Geological Survey for the purpose of surveying portions of the Tertiary volcanic region of the West of Scotland, your ten years' service produced two important memoirs, on the Tertiary igneous rocks of Skye and on the Small Isles of Inverness-shire. In addition to these, and many other records of observations, your work has always been characterised by a breadth of view and a recognition of fundamental principles. Applying the results of physical chemistry to the differentiation of rock-magmas, you have indicated a manner in which a separation of the alkaline and calcic portions might be brought about, and you were the first to draw attention to the correspondence of the distribution of these types with areas characterised by the Atlantic and Pacific types of coast-line. Your work on the "Natural History of Igneous Rocks," and your addresses to the British Association and to this Society, have all been important contributions to theoretical geology. For these reasons the Council has accorded to you the Wollaston Medal, in recognition of those manifold services, by which you have advanced our knowledge of the mineral structure of the earth, both in the narrower and in the more extended meaning of the words.

Dr. Harker replied in the following words:—

Mr. PRESIDENT,—

I wish to express my keen appreciation of the distinction which has been conferred upon me, and to record my thanks to the Council for their generous estimate of my merits. To so high an honour I have never ventured to aspire. If a perusal of the list of former Wollaston Medallists left me with a lively sense of my own unworthiness, this feeling has at least been tempered by the kind congratulations of friends, and now by the graceful words with which you have accompanied the presentation.

The occasion is one which invites retrospect, and the personal note will perhaps be pardonable. Looking back, I acknowledge that the lines have fallen to me in pleasant places. I should be ungrateful were I to forget the constant support extended to me by my College, or the debt which I owe to Prof. Hughes, who first turned my steps into the paths of Geology. Gratefully, too, I recall the encouragement which I have received from this Society, and from the comradeship of colleagues at Cambridge and many friends in London and Edinburgh. Much of my active life has been passed teaching. If such occupation limits in some measure the time that can be given to private work, it still brings notable compensations. It is good, I think, to be brought back often to first prnciples, and to be braced by contact with younger and more ardent minds. You, Sir, have emphasised the value of field-work in conjunction with laboratory research. It was by the good offices of Sir Archibald Geikie that I have been enabled to enjoy this advantage also, and to acquire some experience of systematic mapping amid the delightful scenes of the West Highlands.

I wish I could believe that all these favours of fortune have been turned to the best account in the service of Geology, but I am conscious of many shortcomings. There remains the hope that some years of activity may still be left for me to justify, if I can, the honour now bestowed upon me.

The President then presented the Murchison Medal to Dr. John William Evans, F.R.S., addressing him as follows:—

Dr. EVANS,—

Taking up the study of geology, originally from pure love of the subject, you have had an extensive, varied, and fruitful experience. In Western and Southern India, and in South America, you have conducted and controlled important geological investigations, contributing largely by your own observations to, and by your writings to the dissemination of, the results; nor have you feared to attack the more abstruse and polemical problems of theoretical geology, of which you have been an eloquent illuminator and interesting exponent.

Dr. Evans replied in the following words:—

Mr. PRESIDENT,—

It is nearly a third of a century since Prof. Judd awarded to me a medal struck from the same die as that which I have just been so fortunate as to receive at your hands. The former was given as an encouragement to one who was commencing his geological career. This medal, I trust, I

can accept as an assurance that I have not entirely wasted the intervening years. If some may think that, in a life with many calls upon it, I have attempted too much and carried too little to completion, I would plead that I have learnt, as I could not otherwise have done, how vast are the problems which our science presents for solution, and have been enabled to assist the younger men, with whom I have come into contact in my College and Colonial Office work ,to realise the wide field of research that lies open before them.

In handing the Lyell Medal, awarded to Dr. Charles Davison, to Prof. W. W. Watts for transmission to the recipient, the President addressed him as follows:—

Professor WATTS,—

The Council has awarded the Lyell Medal to Dr. C. Davison. Not unmindful of his contributions to observational geology, or of his contributions to the problems connected wth the constitution and consolidation of the earth, it has based this award mainly on his lifelong devotion to the study of earthquakes. Commencing at a time when he was almost alone, in this country, as a student of the subject, he has steadfastly accumulated a mass of detailed observations and critical discussion, which has very materially advanced our knowledge. His recognition of the duplex origin of certain earthquakes has been fruitful of result, and has been extended by others, until it is now a truism that the origin of an earthquake need not be from a single centre, but may be of a very complex and extended character.

Prof. W. W. Watts expressed his regret that Dr. Davison was prevented by illness from receiving the Medal in person. He pointed out the appropriateness of the award of the Lyell Medal to one who had done so much to prove the uniformity of geological causes at the present day, and whose method of research was essentially Lyellian in character. He asked permission to communicate Dr. Davison's acknowledgment in his own words:—

"It is with no little regret that I find myself unable to be present at the Anniversary Meeting, and I am writing to ask if you would be so kind as to represent me when the Lyell Medal is presented, and on my behalf to thank the President and Council for their award. It is one that, for several reasons, I value very highly, especially because the Medal was founded by the writer of the remarkable chapters on earthquakes in the "Principles of Geology"; and not less because it is presented by the author of the report on the great earthquake of 1897. I should like to take this opportunity of saying that, whatever success my study of British earthquakes may have attained, is owing in great part to the help and encouragement which I constantly received from Prof. Charles Lapworth and from my old teacher, Prof. Lebour."

CHARLES DAVISON."

The President then presented the balance of the proceeds of the Wollaston Donation Fund to Dr. Leonard Johnston Wills, M.A., addressing him as follows:—

Dr. WILLS,—

Commencing your geological record with a study of the Lower Keuper rocks of Worcestershire, a study of the structure of the lower jaw of the Triassic Labyrinthodonts, and the discovery and description of the fossil plants at Bromsgrove, you have rendered more conspicuous service by your geological work on the Palæozoic rocks of North Wales and the Denbighshire coalfield, in the course of which you have developed important suggestions of tectonics and added to our knowledge of the detailed stratigraphy of the region. Nor have more recent deposits been neglected, as is evidenced by your paper on late Glacial and post-Glacial changes in the Dee Valley, and on windworn pebbles in the high-level gravels of Bromsgrove. These studies you are still continuing, and we look forward to the early publication of some of your results. In recognition of the work done, and as an encouragement to future effort, the Council has awarded to you the balance of the Wollaston Fund, which I now hand to you in the name of the Society.

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING, MARCH 8 & 9.

Held at the House of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

Summary of "Notes on the Corrosion and Protection of Condenser Tubes," by G. D. Bengough, M.A., D.Sc., Member (Investigator to the Corrosion Research Committee), presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

Dr. G. D. Bengough's "Notes on the Corrosion and Protection of Condenser Tubes" deal with ten year's scientific investigation of the problem on its practical side. The recommendations are specific and categorical. and the document should be of considerable service to manufacturers

of tubes and condenser plants, and to the engineers who use them.

Summary of Paper by Frank Adcock, M.B.E., B.Sc., Member (Teddington), on "The Internal Mechanism of Cold-Work and Recrystallisation in Cupro-Nickel," presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

The problem was attacked in a conventional manner, by observing under the microscope the polished and etched surfaces of metal specimens which had been subjected to various degrees of cold working and heat treatment.

Cast cupro-nickel, annealed until homogeneous, was selected as a suitable basic material, since good etchings were obtainable with the citric acid attack (electrolytic). The metal was able to withstand a considerable amount of cold working, and yet was sufficiently hard to permit of rapid preparation for micro examination.

Material which had been subjected to reductions of 50 per cent. and 88 per cent. by cold working was examined, and observations were made on the nature and direction of certain strain planes which passed through most of the crystal grains of the distorted metal.

The possibility of a gradual distortion of the crystal structure apart from "slip" is also dealt with, and reference is also made to the cavities which appeared on etching the worked material.

In order to follow the process of recrystallisation, cold worked specimens which had been annealed for fixed periods of time at progressively higher temperatures were examined microscopically.

It was noticed that the first effect of annealing was the accentuations of the "strain" markings previously visible in the worked specimens, followed at higher annealing temperatures by the appearance of new crystal grains which were generally associated with the previously mentioned "strain" markings and occasionally with old crystal grain boundaries.

New grains which appeared on the sites of the "strain" lines were frequently elongated in the direction of these lines, and not necessarily in the direction of rolling and, further, the crystalline orientations of such grains were apparently not related to that of the old grain in which they were born.

A theory is put forward as an attempt to explain some of the experimental facts which are not altogether in agreement with the usually accepted views on the subject.

The hardness of the cold worked metal as indicated by the "Brindell" test did not begin to fall appreciably until the annealing temperature employed was such that new crystal grains were readily discernible under the microscope.

The paper is illustrated by thirty-six photographs.

Summary of Paper by the Research Staff of the General Electric Company (London), (work conducted by Major C. J. Smithells, M.Sc.), on "The Effect of Impurities on Recrystallisation and Grain Growth," presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

This research was undertaken to determine the effect of small quantities of impurities in tungsten on the structure developed on annealing. Tungsten wires were prepared, containing accurately known quantities of thoria, alumina, silica, lime, and the alkali metal oxides, in various proportions. The progressive changes in crystal structure on annealing at 2,500° K were followed in each case, and the distribution of the impurities in the metal determined. It was found that the refractory oxides, which ultimately segregate in the grain boundaries, exert a definite resistance to grain-growth. An entirely new type of exaggerated growth has, however, been found to take place on annealing tungsten containing a few tenths per cent. of both a refractory oxide and an alkali metal oxide. Single crystals occupying the entire cross-section of the wire, and three hundred times as long as their diameter, are formed on annealing for a fraction of a minute.

The authors put forward an hypothesis based on the idea that crystal growth and recrystallisation in metals depends on a difference in vapour pressure between neighbouring crystal grains. On this hypothesis the new type of exaggerated grain growth is satisfactorily explained.

The authors then proceed to a critical survey of published work on recrystallisation and grain-growth from the point of view of the vapour pressure hypothesis. They show that it explains the known phenomena in relation to the effect of strain, grain-size, and temperature in regulating recrystallisation and grain-growth on annealing.

The paper is well illustrated with photomicrographs, showing the development of

the various types of structure produced on annealing tungsten containing different impurities.

Summary of Paper by H. Moore, O.B.E., Ph.D., F.I.C., Member, and S. Beckinsale, B.Sc., Member (Woolwich), on "Further Studies in Season-Cracking and its Prevention: Condenser Tubes," presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

The work reported in this paper has been carried out with a view to the application to Admiralty condenser tubes of the low temperature annealing, previously recommended by the authors for the removal of internal stress in brass and the consequent prevention of season-cracking. Split tubes showed the usual characteristics of brass which had failed by season-cracking. The properties o fcondenser tubes of 8 different makes, and also of a quantity of tube purposely made by methods inducing a state of high internal stress were determined before and after annealing at temperatures in the range 250° to 325° C. By numerous annealing experiments on flat strips of condenser-tube brass elastically bent to an arc o fa circle, and thus initially stressed to a known amount the effects of (1) initial hardness, (2) initial stress, (3) time, and (4) temperature, on the reduction of initial stress by low-temperature annealing were separately determined quantitatively. It was shown that:—

1.—The rate of reduction of stress at the lower temperatures is fairly rapid at first, but becomes slow when the stress has been considerably reduced.

2.—As the temperature is raised the rate of reduction of stress increases.

3.—The higher the initial stress, the higher is the remaining stress after a given treatment, in condenser tube brass of the same hardness.

4.—The higher the hardness of the brass, the lower is the remaining stress after a given treatment and for a given initial stress.

The elastic limit and yield point of cold-worked condenser-tube brass were found to be raised by treatments which would greatly reduce initial stress, a temperature of 250° to 275° C being the most effective in restoring elasticity in the overstrained material. The Brinell hardness of condenser tubes is commonly between 140 and 160, having been raised considerably by the final cold-drawing. Treatment at 280° to 300° C for 30 minutes is recommended for condenser tubes. This treatment reduces any initial stress present to a safe limit without injury to and in some cases with marked improvement in the strength of the tube.

CHEMICAL NOTICES FROM FOREIGN SOURCES

SOLUTION OF ADRENALIN FOR INJECTIONS —*L. Debucquet.*—A saturated aqueous solution of benzoic acid is a very valuable solvent for adrenalin, the best proportions to use being:—

Adrenalin	1 gramme.
Pure Sodium Chloride ...	1 ,,
Saturated Solution of Benzoic Acid	1000 cc.

This solution is exceedingly sensitive to the action of alkalis, and especially to ammonia, which turns it pink. Iron perchloride gives a blue green colouration which changes to violet if the previously acid solution is neutralised. The rotatory power is constant, and its physiological activity is the maximum obtainable. The solution is acid, but this fact cuses no inconvenience, and very probably the physiological activity is due to the acidity of the medium. The benzoic acid acts as an antiseptic, and the solution remains active and keeps well.—(*Journal de Pharmacie et de Chimie*, XXV., No. 4, 1922.)

RELATION OF CHEMICAL CONSTITUTION AND THERAPEUTIC PROPERTIES—*Paul Putzeys.*—The chain >CO is hypnophoric, and in the series of ketones the appearance of utilisable hyponotic effects is connected with the presence of the ethyl radical C_2H_5. Thus ordinary acetone CH_3-CO-CH_3 produces an intoxicating effect and affects the heart, but diethyl ketone C_2H_5-CO-C_2H_5 is a hypnotic which does not act upon the heart. The accumulation of 3 hypnophores in the molecule seems to raise the hypnotic effect. The halogens combined with alkyl radicals act as hypnophoric agents, and the hypnotic character of a compound seems to be an additive property. The activity of a compound depends not only upon the radicals it contains, but also upon the way in which they are arranged, and thus isomerism plays an important part in determining the properties of a compound. A good example of this is benzoic ortho sulphimide or saccharine, the para derivative being quite tasteless; also cocaine, which differs only from cocaine in the posi-

tion of the carboxyl group, has no anæsthetic action, and lævo-rotatory hyoscyamine is from 12 to 18 times as toxic as the dextro compound. Strychnine contains a lactame group $C=O$, in which the two NH free valencies are bound to the same molecule, and this group seems to possess tetanising properties.—(*Journal de Pharmacie Belgique*, *IV.*, 1922, No. 7.)

SUBSTITUTES FOR CAMPHOR IN THE MANUFACTURE OF CELLULOID — *A. Hutin.* — Triphenyl and tricresyl-phosphates have been employed successfully as substitutes for camphor in making celluloid, while triacetine, ethylacetanilide and other substances can be used to replace part of the camphor. Most of the substitutes proposed are acids, amines or esters, all of which are saponified or hydrolysed easily, and thus produce acids which accelerate the decomposition of the compound and act upon the nitrocellulose. The chemical properties of camphor make it the ideal solvent for nitrocellulose. It is a saturated cyclic ketone, and thus a relatively stable compound, but is oxidised by the air at the ordinary temperature. The best substitutes for camphor are compounds of similar structure and triphenyl phosphate and tritolylphosphate are the only two which have been employed successfully on the large scale. The former is a white solid, melting
at 49 °C, while the latter is a viscous liquid
the worked mate... thick at 30° but does
In order to follow the colourless sub-
crystallisation, cold worked cell, non-
which had been annealed for fixed d boil-
of time at progressively higher temp. do
tures were examined microscopically. it.

It was noticed that the first effect of annealing was the accentuations of the "strain" markings previously visible in the worked specimens, followed at higher *annealing temperatures by the appearance* of new crystal grains which were generally associated with the previously mentioned "strain" markings and occasionally with *old crystal grain boundaries.*

New grains which appeared on the sites of the "strain" lines were frequently elongated in the direction of these lines, and *not necessarily in the direction of rolling* and, further, the crystalline orientations of such grains were apparently not related to that of the old grain in which they were born.

A theory is put forward as an attempt to explain some of the experimental facts

and allowed to harden. The material is then broken up and extracted with ether in a Soxhlet's apparatus. When the ethereal solution is concentrated, a strongly acid black syrup remains if lactic acid is present. A 0.2 per cent. solution of it is then made and tested as described above. Formic, *acetic, malic, citric, benzoic and salicyclic* acids give no colouration in these conditions, but tartaric acid gives a faint pink colour, which, however, cannot be confused *with the red colouration given by lactic* acid.—(*Chem. Ztg.*, *XLV.*, 1921, No. 40.)

NOTES ON BOOKS.

Soaps and Proteins, their colloid chemistry in theory and practice, by MARTIN H. FISHER, GEORGE D. MC LAUGHLIN, AND MARIAN O. HOOKER.

The author states that the widely differ ing theoretical and practical problems asso ciated with normal physiology in plants an animals, and with the treatment of thei diseases are essentially problems in colloi chemistry. Soaps were chosen on accoun of their chemical behaviour being similar t *that* of the proteins.

The book is divided into three parts– Part I., the colloidal chemistry of soaps occupying the main portion of the boo *The subject is dealt with exhaustively*, an is very freely illustrated with photograph and original diagrams. Part II. deals wit the colloidal chemistry of soap manufa ture, and Part III. is devoted to the an logues in the colloidal chemistry of soap protein derivatives, and tissues. The boo concludes with a short appendix givir physico-chemical constants and other dat

We have received from Messrs. Lon man, Green & Co., publishers to the Ma chester University Press, the Roll of Se vice of the Manchester University, givi the names of all those members of the u versity who took part in the recent war. short preface is given by the vice-chancello Henry A. Miers, giving the details of t roll and adding a few words to futu generations of students as to the example those who went out from the university a offered their lives for their country in t great war. The vice-chancellor points c that heroism is no monopoly of war, a that there are sacrifices as great as that life, and hardships equal to those of batt

The list of those university men who i the great war has been arranged

alphabetical order, with the details of their careers and the manner of their deaths, and occupies some 80 pages, and following that some 200 pages are taken up with the names of those who served in the Army and Navy. The roll can be obtained from the publishers, 39, Paternoster Square. Price 10/- net.

"Sell's Registered Telegraphic Addresses and Classified Trades Directory of Great Britain and Ireland," Messrs. Sell's. Pages: xxviii.-2,976. Messrs. Sell's, 1922 Edition (37th year). Price: 45/-.

A SENSITIVE TEST FOR PHENOLS, BY JAMES MOIR, M.A., D.Sc., F.I.C.—*Read 19th September*, 1921.—For phenols as such—i.e., not in solution, the best test is undoubtedly the distinctive colour of the phthaleins produced when the specimen is gently warmed with a trace of *p*-oxybenzoylbenzoic acid and a drop of sulphuric acid, and the resnlt dissolved in ammonia (see Moir, *Trans. Royal Soc., S.A.*, 1918, 112; also Orndorff & Murray, *J. Amer, C.S.*, April, 1917).

It is well-known, however, that the ordinary tests for phenols break down if the reaction of the fluid to be tested is either markedly acid or markedly alkaline. The ferric chloride coloration for example can in practice only be obtained with a pure aqueous distillate containing nothing but phenol and water. Similarly tribromophenol is not characteristic, except in smell, unless perfectly pure. The mercury test and the chloroform test do not apply to dilute solutions.

Having had occasion to detect phenol in soap, in which the proportion of phenol was not more than 0.01 p.c., I devised the following process, which can be carried out if necessary on the original without distillation. The reagent is paranitraniline hydrochloride, and is made up in the same way as "Reagent A" of my test for nitrous fumes (*This J. IV.*, January, 1921, foot of page 5), viz., 1.5 grams paranitraniline base dissolved in 500 cc. of hot water with the aid of about 4 0cc. of strong hydrochloric acid.

For a test, the solution suspected of containing phenol is roughly neutralised if very acid or alkaline and treated with ½ gram of sodium acetate. 5 cc. of the yellow paranitraniline reagent is taken and treated with dilute sodium nitrite solution (slowly) until it becomes colourless (but a moderate excess over this stage does not matter). The mixture is then added to the suspected fluid, when a pale yellowish flesh-colour develops. An orange precipitate is obtained if much phenol is present. After waiting a minute excess of caustic soda is added when a deep colur is obtained, ruby-red if much phenol is present, rose-red if over 0.01 p.c., and salmon-coloured if only a few parts of phenol per million of fluid are present. The latter colour, if sufficiently dilute, shows in in the spectroscope a broad absorption-band at λ 494, whereby phenol may be distinguished from the cresols and other substances which give colours with the reagent. Even with the eye the distinction can be made, since the colours given by the cresols are rose-pink, and that given by naphthol, blue.

The phenol colour is due to nitrobenzene-azophenol, which in presence of caustic soda is ionised to $(O:C\ H_4:N_2:C\ H_4:NO_2)$ which is deeply coloured on account of its peculiar constitution.

It is probably safest in all cases where a doubtful colour has been obtained by the reagent,- to distil the suspected liquid and *repeat the test on the distillate*: otherwise certain non-volatile phenolic substances such as tannin (which gives an inky colour with the reageut and caustic soda) may cause confusion.

Working with test-tube quantities and avoiding excess of the reagent, phenol in a *dilution of one part per million can be* detected.

The mixed (paranitraniline-nitrite) reagent keeps for quite a long time. It is, in fact, a trade article (for dyeing) in England, known by the various names: "nitrosamine-red," "nitrazol C," "azogen-red." "azophor-red," "benzonitrol," etc.

LITERARY INTELLIGENCE.

The following volumes will be published shortly:—

"The Colloid Chemistry of the Proteins," by Professor Wolfgang Pauli, translated by P. C. L. Thorne, M.A. There are 27 diagrams and numerous tables.

"The Principles of Radiography," by J. A. Crowther, Sc.D., F.Inst.P., University Lecturer in Physics applied to Medical Radiology, Cambridge. This volume contains 55 illustrations, and deals with the physical side of the subject.

By Messrs. J. & A. Churchill.

The Popular Chemical Dictionary (Second
By Messrs. Baillière, Tindall & Cox.
Edition), by C. T. Kingzett, F.I.C., F.C.S.

VITAMINS AND THE CHOICE OF FOOD.—Under the above title, Mrs. Violet G. Plimmer, *Associate of the Royal Sanitary* Institute, and Dr. R. H. A. Plimmer, Professor of Chemistry in the University of London at St. Thomas's Hospital Medical School, have written a book which is intended *for the general reader, especially* those who are responsible for the feeding of large numbers, such as the principals of schools and colleges. It should also interest medical practitioners and medical and agricultural *students. It gives a short* account of the medical and scientific investigations which preceded the recognition of vitamins and the need of these substances in nutrition.

Laboratory experiments on the feeding of animals with chemically pure foodstuffs led to the discovery that for the maintenance of life and health there must be present in the food small quantities of some unknown substances. These are called accessory food *factors or vitamins.* The existence of three distinct vitamins has been detected. It is shown that rickets and some other diseases are associated with a deficient supply of the A-vitamin; beri-beri is caused by the absence of the B-vitamin; and scurvy by the absence o fthe C-vitamin from the food. Many of the intestinal and other chronic disorders so common in civilised countries are traceable to the long continued use of food poor in vitamins. In large towns a relatively small amount of natural food-stuffs is now consumed. Many food-stuffs are subjected to commercial processes, such as machine-milling, refining, desiccation, sterilisation, etc., and are robbed thereby of these indispensable substances. Common errors in the selection and preparation of *food-stuffs are pointed out.* Tables, showing the distribution of the three vitamins in common food-stuffs are given, and should be o fassistance to those who are responsible for the selection of food in schools and other large communities. The vitamin value of some common food-stuffs for cattle and poultry are included in the tables.

The significance of the *kind* of protein in the food is emphasised; the disease pellagra is caused by a diet containing protein derived almost entirely from the seeds of plants, with little or no animal flesh, milk, or eggs.

Throughout the book special attention is given to the vitamin requirements of the infant and growing child. The problem of the marasmic infant is considered.

The volume, which will be illustrated, will shortly be published by Messrs. Longmans, Green & Co.

GENERAL NOTES.

Abstracts of Papers recently Published in the "Astrophysical Journal."

NYSWANDER, R. E., LIND, S. C., AND MOORE, R.B.—The Spectrum of Radium Emanation. *Astrophysical Journal,* 54, 285—292, November, 1921. The University of Chicago Press, Chicago, Ill.

ABSTRACT.

Spectrum of RaEm, λλ *5982 to 7450.*—Two capillary discharge tubes were filled with 0.2 and 1 curie of carefully purified emanation, respectively, and both visual and photographic *measurements* were made with a 4-prism spectrometer. The relative intensities of the lines differed markedly, as *a rule, from the previous observations* of Watson and Royds and Rutherford; many strong lines of the 120 previously measured were not found, and yet of the 44 lines obtained, 9 are *new lines. Changes of intensity with duration of the discharge* were noticed, some lines decreasing, some increasing in strength, while the colour of the discharge changed from a bright glow to violet. λ 5483 and some other *lines flashed out on reversing the current* after a thirty-minute run and then quickly disappeared.

Occlusion of RaEm in discharge tube.—After a discharge had passed through the glass capillary tube containing 0.2 curie for 5 hours, 35 per cent. of the emanation had been occluded, most of it in the platinum *mirror surrounding the cathode.* The other tube became quite hard after a four-hour run.

Modification of Duane's apparatus for purifying RaEm.—The copper wire used to remove oxygen and hydrogen is spirally wound on a silica tube and is heated indirectly bp an electrically heated Pt wire passing through the tube, instead of directly by a current through the Cu wire. This arrangement requires less current and less attention.—GORDON S. FULCHER.

FABRY, CHARLES, AND BUISSON, H.—A Study of the Ultra-Violet End of the Solar Spectrum. *Astrophysical Journal,* 54, 297—322, December, 1921. The University of Chicago Press, Chicago, Ill.

ABSTRACT.

Solar spectrum from λ 3150 to λ2900A.—To obtain photographs of this region it is necessary to eliminate diffuse light of longer wave-length. This was done by using a *double spectrograph* consisting of two quartz spectrographs in series arranged with their dispersion planes at right angles. The intensity of the spectrum falls off very rapidly, being only one-millionth as great at λ 2900 as at λ 3150; therefore, to enable the whole region to be photographed at once for measurements of absorption, *two absorption screens* made by intensifying photographic films with $HgCl_2$ were used in echelon to reduce the intensity of λ 2990. To obtain a *photographic map* with uniform normal exposure throughout, two plates, each covering half the region, were exposed by moving a shutter by hand at proper predetermined rates across each spectrum. The wave-lengths will be published soon.

Absorption of the atmosphere for λ 3150 to λ 2900 A.—By comparing the intensities of spectrograms taken for various zenith angles, the *coefficients* for various wave-lengths were determined. The effect of molecular diffusion was corrected for by using the Rayleigh formula, and the effect of haze was eliminated by assuming it independent of wave-length. A comparison with the corresponding coefficients for ozone, previously determined by the authors, shows remarkable agreement, leaving no doubt that this absorption is due to ozone.

Ozone in the atmosphere is found to be equivalent to a layer about 3 mm. thick at atmospheric pressure. The *daily values* for May and June, 1920, varp irregularly from 0.29 to 0.34 cm. It would be interesting to follow these *variations* through a solar period. It is shown that the *location of this ozone* must be in the outer layers of the atmosphere, above 40 km. and in *explanation of its origin* it is suggested that the ozone is produced by solar rays of wave-length shorter than λ 2000 which penetrate only the outer layers, and that longer rays dissociate the ozone and prevent its accumulation beyond the amount for equilibrium.

Distribution of energy in the solar spectrum outside our atmosphere for λ 3150 to λ 2900 A was determined by correcting the observed intensities for the absorption by the atmosphere and then reducing to units of energy by the use of a calibration-curve obtained by comparing the intensity-curve of an arc with the radiation from a black body at 3750° Abs. The energy-curve thus obtained shows only a gradual slope toward the shorter wave-lengths. For λ3143, λ 2997, λ 2922, and λ 2898 the relative energies for the sun outside the earth's atmosphere come out 155,000, 218,000, 145,000, and 45,000 respectively, while at the surface of the earth when the sun is at the zenith the corresponding values are about 22,400, 1320, 2.2, and 0.02.—GORDON S. FULCHER.

New Patents.

THIS list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

4835—Ashcroft, E. A.—Electrolysing fused salts of metals and recovering metals and acid radicles, etc. Feb. 18.

4435—Blanc, G. A.—Method for seperation of chlorides of aluminium and potassium present in mixed solutions obtained in the treatment of leucite. Feb. 15.

4437—Blanc, G.A.—Methods for treatment of alum to obtain sulphates of potassium with ammonium and free alumina. Feb. 15.

4492—Dehn, F. B.—Deriving hydrazobenzol, etc. Feb. 15.

4607—Hawthorn, E.—Process for purifying oils containing sulphur. Feb. 16.

4626—Imray, O. Y.—Manufacture of azo dye-stuffs. Feb. 16.

Specifications Published this Week.

174653—Naef, E. E.—Manufacture of sodium compounds and by-products.

154579—Wohl, A.—Production of aldehyde and acetic acid.

174784—Dawson, W. H.—Process for the Purification of anthraquinone.

156187—Chemische Fabriken Worms Akt Ges—Process for regenerating metallic mercury.

174878—South Metropolitan Gas Co., Evans, E. V., Parrish, P., and Wight, O. W.—Manufacture of ammonium sulphate.

Abstract Published this Week.

Lithopone.—Patent No. 173,567.—A new process for the manufacture of Lithopone has been in-

vented by Mr. J. L. Mitchell, of 17, West 108th Street, New York, U.S.A.

The precipitate of barium sulphate and zinc sulphide is dried and pulverised and then calcined at a temperature of 700-950° C. with constant agitation, preferably with exclusion of air. The calcined product is quenched in water, dried, and re-ground. The calcining apparatus comprises a cylinder which is heated by gas-burners or other means, and contains an agitating-screw, the motion of which is periodically reversed automatically. The pulverised dried precipitate is fed through an adjustable gate and doors, which prevent access of air to the furnace, and the discharge is effected through outlet doors, a water-trough from which the quenched product is removed by the conveyer. The furnace and the delivery chamber are provided with water-sealed outlets, for the escape of vapour.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3232.

GERMAN DYES.

In the House of Commons, on Monday, March 13, Mr. Baldwin informed Col. P. Williams that under the Reparation Clauses of the Treaty of Versailles, Germany accorded to the Allies certain options on the stocks of dyes in that country at a fixed date, and on the output for a period of five years which ran from Jan. 1st, 1920. Inasmuch as the second option was a continuing one, and the extent of which it was exercised and the prices of any dyestuffs taken must depend on current market conditions, it was impossible to form any estimate of the total value of the dyestuffs covered by the Treaty provisions. The fullest possible use was being made of those provisions, and the German obligations had been fully carried out: but there was no obligation on the German manufacturers to produce according to the requirements of the Allied countries. The quota which the Allies could take was strictly limited, and that quota had to be allocated between all the Allies. Consequently, it was necessary to supplement Reparation supplies by suplics from other courses, and for these licences were necessary.

The Central Importing Agency was under the control of the Board of Trade only in so far as it acted as the agent of the Board of Trade for the distribution of Reparation dyestuffs, for which it was remunerated on a commission basis. Separate accounts were kept of all the transactions of the agency in respect of such dyestuffs. The Board had no control over any other operations of the agency or over the appointment or remuneration of its staff.

Further questions have been asked in the House of Commons with regard to dyestuffs. Mr. Baldwin, President of the Board of Trade, in reply, stated that he understood that the Dyestuffs Development Committee was engaged in a very careful survey of the precise extent to which British manufacturers were in a position to meet the requirements of British consumers of dyestuos, in order to ascertain as definitely as possible the directions in which it was of chief importance that production should be tial to the proper consideration of the whole problem, was obviously a very difficult one, and it would not be right for him yet to ask the Committee for a report. The Committee consisted of three representatives of the dye-makers, five representatives of the dye-users, and three independent representatives. Four of the five representatives of the consumers had been appointed by the Board of Trade on the nomination of the Colour Users' Association, which comprised the great majority of the colour users. Should any members of the Association be dissatisfied with the proceedings of those representatives, it was, of course, open to them to take steps within the Association with the object of bringing about a change.

Mr. Baldwin added that he was aware that considerable stocks of German dyes were being carried by agents in this country. During the period in which there was no restriction on importation, quantities of dyestuffs greatly in excess of current trade requirements were imported by the agents, and the prolonged trade depression had no doubt very much delayed the liquidation of the stocks.

THE ATOMIC THEORY IN 1921.

(Continued from Last Week.)

Presidential Address, Section B., S. African Association for the Advancement of Science, Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S,

The second point concerns Moseley's law, for the K-lines in X-ray spectra. The expression $^1/\lambda = K(N-1)^2$ becomes $^1/\lambda = K.2$ for lithium. If we make the simple assumption that H+ is a nucleus and the only free nucleus known (omitting the products of radioactivity), hdrogen becomes an entity *sui generis*, and the first real ordinary atom is helium. Moseley's law then becomes $^1/\lambda = K_1 (N+1)^2$, in which N is zero for helium and is not the atomic number, but the number of *valency* electrons in the smaller elements. For higher elements N is the number of electrons outside the Kernel.

For the L series of lines in the higher elements it is possible that the law is that $^1/\lambda$ varies as the square of the atomic *weight* (not number) counting neon as zero

number (i.e., subtracting 20), viz., $\sqrt{1/\lambda} = C(A-20)$ instead of $\sqrt{1/\lambda} = \frac{5}{27} K (N-7.4)^2$ as given by Moseley.

Some account of Gilbert Lewis's octet theory (*J. Amer Chem. Soc.*, 1916, 768), which is almost certainly true for the elements higher than oxygen, may now be given.

Fluoride, ion neon and *sodium ion* all have the same octet of electrons, but in *fluorine atom* one is missing, leaving a "hole." In *sodium metal* one is in excess. In sodium fluoride the extra electron of *sodium metal fills the hole in the fluorine* atom: both then become ions even in the crystal state, and both have complete octets, thus: —

$[4\Theta\ (Na+^9)\ 4\Theta]\ \Theta\ +\ 4\Theta\ [F+^7]\ 3\Theta\ =$
Metal, kernel
and electron.

$[4\Theta\ (Na+^9)\ 4\Theta]\ [4\Theta\ (F+^7)\ 4\Theta]$
sodium ion Fluoride ion
Sodium Fluoride crystal.

Note.—The expression $Na+^9$ is really $Na+^{11-2}$, the atom having 2 inner electrons to make a kernel out of a nucleus (see page 4).

The fundamental conception might appear (reading Lewis strictly) to be that the same electron belongs to two atoms when a compound is formed, but undoubtedly in the *ionisable* compounds the metal electron is transferred and the residue, which is the metal ion, is quite independent, not only in solutions but in crystals, the atoms in which are simply held together because one ion is positive as a whole and the other negative as a whole. In the case of such a *compound as chlorobenzene*, however, the chlorine is completely un-ionised, and it is to be assumed that the chlorine is much closer to the rest of the molecule and has an electron in common with the carbon to which it is attached. The chlorine "shell" is a cube* and the carbon "shell" a tetrahedron, and the corner or point of junction is the same electron. Generally speaking, the conception is that when 8 electrons get established round a nucleus, the result is a saturated body which is incapable of further chemical action: it is only rendered active again by electrolysis or analogous process.

* *Or Sir J. J. Thomson's skew-cube*

There are great difficulties in accepting Gilbert Lewis's octet theory of valence for the lower elements, although it is probably true for the higher elements. The new suggestion I wish to bring forward is, as already said, that the arrangement or structure of the nucleus governs the structure of the valency electrons in the smaller atoms. The nucleus, although its actual weight has nothing to do with chemical properties, thus indirectly influences the direction in space of the valency electrons, and consequently affects the chemical properties of the atom by its *arrangement*, not by its size. Thus, to make my position quite clear, even at the risk of repetition, the arrangement of the carbon nucleus has the shape of a regular tetrahedron, that of the nitrogen-nucleus, the shape of a tetrahedron or pyramid with one point farther from the centre than the other three, and that *of oxygen the shape of an irregular* tetrahedron with two points nearer and two points farther from the centre. Each valency electron in the case of carbon has its average position in line with a projection of the nucleus, giving a regular tetrahedral result.

In nitrogen, 3 of the valency-electrons are arranged as in carbon, namely, in line (from the centre of the nucleus) with the 3 nuclear points which are nearer the centre: whilst the other two form a saturated pair lying opposite the fourth point of the *nucleus where the group X + is attached to* the nucleus. Putting Z for the arrangement of Fig. 6, X for that of Fig. 5, the carbon becomes $(Z_4 + 2\Theta)$, the carbon kernel becomes $(Z_4 + 2\Theta)\ 2\Theta$, and the carbon atom becomes $[(Z_4 + 2\Theta)\ 2\Theta + 4\Theta]$, the whole arrangement being tetrahedral. The nitrogen nucleus is $(Z_4 + 2\Theta + X)$ or $(Z_3 + 2\Theta + Z\ X)$; the nitrogen kernel has two more electrons, so that the nitrogen atom is $Z_4X + 4\Theta$, or the carbon nucleus plus X plus 2Θ.

Nitrogen gas N_2 is thus of the same structure as acetylene, i.e., CX : CX, as compared with CH : CH; and the "metameric" *gas carbon monoxide has the same external* structure as nitrogen and acetylene, i.e., *each atom* having 5 electrons round it, of which two for ma neutral pair. The ordinary notation of this formula would be C : O, which on my theory (and referring to the *nuclei only*) is $C : CX_2$.

This, of course, involves the actual transfer of an electron from the oxygen atom to

theory explains well why the two gases are almost identical physically, whilst there are still two "shells" in agreement with the C_p/C_v ratio, which is violated by the Lewis-Langmuir theory of two nuclei inside one shell of electrons. The existence of nitric oxide in the form of NO instead of N_2O_2 is a stumbling block for all the existing theories of chemical affinity. The problem is analogous to the existence of free atoms in sodium vapour and hot iodine vapour. Probably the best provisional explanation on my theory is to formulate it like carbon monoxide, thus employing 10 of its 11 electrons, leaving the extra electron in an outside position similar to that of sodium metal.

The nature of ammonia gas and ammonium ion may next be discussed. The former may be written, following Lewis, as

$$\begin{array}{ccc} & \Theta\Theta H & \\ \Theta\Theta N & & \Theta\Theta H \\ & \Theta\Theta H & \end{array}$$

which, having altogether 17 plus and 17 minus charges, is neutral. It has, however, at one end a free pair of electrons, and therefore has an affinity for hydrion, which can add on at that point, giving ammonium ion, a substance which has the *same saturated tetrahedral configuration as methane*, but has a total of 18 plus and 17 minus charges, and is therefore positively monovalent. Ammonium chloride contains this ion, and the chloride-ion existing side by side at some distance from each other, just as in sodium fluoride previously discussed. When the latter is electrolysed the fluoride ion loses an electron, whilst the sodium ion gains an electron and thus becomes metal. In the case of ammonium also, no doubt the metallic phase $(NH_4\ {}^{18}{+}_{17}\Theta)\Theta$ must come into existence for a moment, but since the external electron must be near a group $\Theta\Theta H$, the result is dissociation into Θ and $(H+\Theta)$, Θ i.e., into NH_3 gas and nascent hydrogen.

The nature of water and steam on this theory is worth notice. Following the analogy of ammonia as related to methane, water (vapour) becomes

$$\begin{array}{c} \Theta\Theta\ \ \Theta\Theta H \\ O \\ \Theta\Theta\ \ \Theta\Theta H \end{array}$$

which altogether has 18 plus and 18 minus charges, so is electrically neutral. It has two pairs of electrons left free, and thus can combine either once or twice with hydrion, giving $(OH_3)+$ and $(OH_4)++$. Liquid water and ice are the hydrates of these complex ions, $(OH_3)+\ (OH)$ being H_4O_2, and H_6O_3 being $(OH_4)++\ (OH)_2$. This theory accounts for the very low dissociation of water since owing to the combination, viz., $[OH_3\ {}^{19}{+}_{18}\Theta]$ $[OH\ {}^{17}{+}_{18}\Theta]$ there is scarcely any free hydrion, the constitution being not unlike that of C_2H_6. No doubt aqueous hydrochloric acid, when strong, contains (OH_3) Cl and $(OH_4)\ Cl_2$. On this theory the angle between the two valencies of oxygen is not very different from that in the case of carbon. Hence H-O-H is misleading, and H_2O should be printed $O{<}^{H}_{H}$.

Another spatial consideration is that NH_4 ion, owing to the fact that the tetrahedron of hydrogens which is attached to *valency* electrons is far out from the N atom, has an abnormally large volume (as compared with sodium). This agrees with the fact that ammonium and the large atom rubidium (weight 85) are mutually replaceable in crystals.

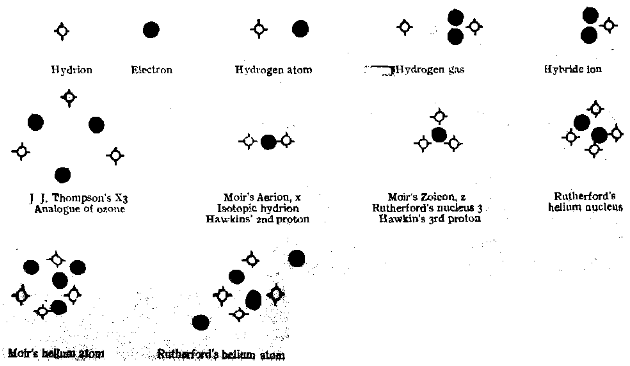
The conceptions for KNO_3 and $KClO_4$ are specially interesting. The NO_3 ion has 23 plus charges (3 sixes from oxygen and one 5 from nitrogen) and 24 binding electrons (3 octets): its valency is therefore -1, the same as that of fluoride ion (valency +7-8). Similarly the ClO_4 ion has 7 + (4x6) = 31 plus charges, and 32 binding electrons (4 octets), giving a total valency of -1 also: similarly SO_4 has 30 plus and 32 minus, giving a valency of -2; PO_4 similarly is 29 plus and 32 minus = -3. This paper would not be complete without some account of the nature of the spectrum lines of the elements. In the first place it is known that these lines, like the valency of the element, have their origin in the outermost electron-shell of the atom. The spectrum of hydrogen which by theory arises from a single electron has been already reduced to a mathematerial formula, viz., $1/\lambda = 1097\left(\frac{1}{2^2} - \frac{1}{N^2}\right)$ in which N is $\frac{1}{2} - \frac{1}{N}$ successively 3, 4, 5, 6, etc. This is a harmonic series, beginning with λ 6563 (line C of the sun), and terminating by superposi-

tion at $1/\lambda = 1097/_4$ or $\lambda = 3650$. Hydrogen has *also an ultra-violet spectrum for* which $1/\lambda = 1097\ (1 - \frac{1}{N^2})$ and N is 2, 3, 4, etc., successively. Similar, but more complex formulæ, also depending on inverse squares of natural numbers, hold for the other elements

N. Bohr has suggested that the cause is revolution of the electron in a constant slightly-elliptic orbit round tbe nucleus, with the possibility of it suddenly jumping from one orbit to another, thus giving what is called a *quantum* of radiation. The mathematics of this peculiar theory lead not only to the above formula for the frequency of the different kinds of light emitted, but also predict the fine structure of the spectrum lines when seen under high resolution. Nevertheless Sir J. J. Thomson declares that when there are several electrons no stable orbit is possible, so he suggests that the electrons vibrate in and out instead of round, that the nucleus repels when the electron goes near and attracts when it is far, thus giving a neutral position where there is no force, which neutral position is that of the electron in the unstimulated atom. This theory also leads to the octet (skew-cube) arrangement when the number of electrons is large. Now in crystals it is known that there also resides a *repulsive force preventing compression* and varying as the inverse tenth-power of the distane, so we see *that* crystallography also is bein gswallowed by Physics just as Chemistry has been, and this unification of the Sciences is all to the good.

In conclusion, I have to apologise for *being unable personally to represent some* of the other Sciences comprised in Section B. I invite the attention, however, of the devotees of that non-experimental science Geology, to the possibility that some of their cherished replacement theories may have to go to the wall—in other words that what appears to be replacement may be transmutation. Thus carbon appearing in silica is very easily explained if silicon nucleus is CHe_4 as I suggested in 1909. So if zirconium-nucleus is CNe_4, titanium Si Ne and niobium N Ne_4, their genesis becomes easily understood. The pressures in the interior of the earth may be sufficient to overcome the repulsive force in the atoms (even though, as already said, it varies as $1/d^{10}$) and thus transmits them by simple squeezing. Such minerals as the trio $SrSO_4$, YPO_4, and Zr SiO_4 could be changed into one another quite easily on this theory, by moving one or two hydrions only. When I have come across an ordinary geological theory, I have always felt like Cato "*Semper miror quod non rideat haruspex* haruspicem quum viderit,*" so when Geologists meet and see one another here in this section I hope they will take the hint and wink discreetly.

* In modern parlance "A Certificated Inspector of Entrails."



PROCEEDINGS AND NOTICE OF SOCIETIES.

THE ROYAL SOCIETY.

List of papers read on March 23rd, 1922:

SIR RICHARD GLAZEBROOK, F.R.S.—The Specific Heats of Air, Steam and Carbon Dioxide.

LORD RAYLEIGH, F.R.S.—A Photographic Spectrum of the Aurora of May 13th-15th, 1921, and Laboratory Studies in connection with it.

F. A. FREETH.—The System: Na_2-CO_3-NaCl-H_2O. Communicated by Prof. F. G. Donnan, F.R.S.

M. A. CATALAN.—Series and other Regularities in the Spectrum of Manganese. Communicated by Prof. A. Fowler, F.R.S.

D. W. DYE, B.Sc.—Calculation of a Primary Standard of Mutual Inductance of the Campbell Type, and Comparison of it with the similar N.P.L. Standard. Communicated by Sir J. Petavel, F.R.S.

P. E. SHAW and N. DAVY.—The Effect of Temperature on Gravitative Attraction. Communicated by Prof. E. H. Barton, F.R.S.

ORDINARY MEETING, MARCH 9, 1922.—*Sir Charles Sherrington (President), in the chair.*—The Bakerian Lecture was delivered by Prof. T. R. Merton, F.R.S., and Mr. S. Barratt on "The Spectrum of Hydrogen."

Summary:—

The Balmer series and the secondary spectrum of hydrogen differ in the conditions most favourable for their production, the secondary spectrum being characteristic of pure hydrogen and feeble discharges. Impurities weaken the secondary spectrum and enhance the Balmer series. Owing to the enormous number of secondary lines, ergularities are hard to recognise, but the lines can be classified in different physically related groups under different conditions, depending on the pressure of gas in the discharge tube, the conditions of excitation, &c. The secondary spectrum is modified in a striking manner by admixture of helium with the hydrogen.

These methods of classification are compared with the regularities discovered by Fulcher and investigations of the Zeeman effect. The Balmer series appear in most celestial spectra. There is no evidence that lines of the secondary spectrum are present in the solar spectrum. There has been some doubt whether the secondary spectrum is due to the atom or the molecule. Measurements of the widths of the lines by a new method which is independent of estimates of "limiting visibility" show that the secondary spectrum is due to the molecule. There is reason to suppose that determinations of the wave-lengths of lines of spectra, other than those from gases at low pressure and excited by uncondensed discharges, may be subject to a serious source of error, and the reality of certain changes of wave-length of spectrum lines may perhaps be suspected.

There is evidence that when the current density of electrical discharges through vacuum tubes is great a partial separation of the gases contained in the tubes may be effected. A number of phenomena are considered in relation to this effect, which may perhaps have some bearing on the interpretation of certain celestial spectra. There is much evidence for a specific influence of neighbouring atoms on the spectra emitted. The effect of helium on the secondary spectrum of hydrogen is not unique, and a particularly striking case is found in its effect on the spectra associated with carbon. A study of the broadening of spectrum lines also leads to the conclusion that there is a specific influence of neighbouring atoms.

GEOLOGICAL SOCIETY OF LONDON.

Report of Annual General Meeting, held February 17, 1921, the President, Mr. R. D. Oldham, F.R.S., in the chair.

(Continued from last week.)

In presenting the balance of the proceeds of the Murchison Geological Fund to Herbert Bolton, M.Sc., the President addressed him in the following words:—

MR. BOLTON,—

The Council has awarded to you the balance of the Murchison Fund, in recognition of your contributions to our knowledge of the stratigraphy and fauna of the Carboniferous System and of your continued and successful conduct of one of the most progressive of our provincial museums. As an authority on the insects of the Carboniferous Period, you are conspicuous. The results of your labours, in the rescue, preservation, and description of these relics of a long-bygone past, have proved of supreme interest in establishing the great antiquity

of some of the common insect-types of the present day. Added to this, your studies of the faunal stratigraphy of the Carboniferous rocks of the Bristol coalfield have been of value, which has led to their publication in our Quarterly Journal. For these reasons the Council has made this award to you, in recognition of the work which you have done in the past, and as an encouragement to others to emulate your example.

The President then handed the balance of the proceeds of the Lyell Geological Fund, awarded to Mr. Arthur Macconochie and to Mr. David Tait, to Dr. J. S. Flett for transmission to the recipients, addressing him as follows:—

Dr. Flett,—

The balance of the Lyell Fund has been awarded in two moieties to Mr. A. Macconochie and Mr. David Tait, in recognition of their joint and individual contributions to the advancement of geology. During his service as fossil-collector on the Geological Survey of Scotland, Mr. Macconochie was the discoverer of one of the most notable fossil localities in Scotland, where, at Glencartholm in Dumfriesshire, he found, in Lower Carboniferous shales, a large number of new genera and species of plants, crustaceans, fishes, and land animals, and was the discoverer of the *Olenellus* fauna in the North-West Highlands, a discovery which caused the renaming of two of the rock-groups of that region. Conjointly with Mr. Tait he collected a new fish-fauna from the Downtonian rocks of Lanarkshire, which, in the words of Dr. R. H. Traquair, opened out a new vista in the field of Palæozoic ichthyology. Mr. Tait, by his investigation of the Rhynie chert-band, was able to establish conclusively its true age as Old Red, and the investigation of his collections has thrown much light on the problems connected with this oldest land-flora. I have referred briefly to the more outstanding of their individual contributions to knowledge, made during a long and devoted service, which has yielded a large body of material for detailed investigation by others. In recognition of this, I ask you to accept and transmit these awards to their respective recipients in the name of the Geological Society of London.

The subject of the Presidential Address was the Cause and Character of Earthquakes, using the word in its original sense of the disturbance which can be felt and, when severe, causes damage, as apart from that which gives rise to distant records, only obtainable by special instruments. The character is sufficiently established as a form of elastic wave-motion, of extreme complexity; this is present in all cases, and may be distinguished as the orchesis of the earthquake. In addition there is, in some cases, a molar, permanent, displacement of the solid rock, which forms the mochleusis. Further, it has been shown, definitely in one case and inferentially in others, that, where mochleusis is present, the disturbance of the surface-rocks, to which the earthquake proper can be referred, is only the secondary result of a more deep-seated disturbance, which has been distinguished as the bathyseism. The origin of the elastic wave-motion must be a sudden disturbance of some sort; the depth of origin can, in many cases, be shown to be very moderate, not more than about 10 miles, and in this outer portion of the Earth's crust the only sudden disturbance conceivable is fracture, due to strain in excess of the power of resistance. In certain cases such fracture, accompanied or not by displacement, has been recognised at the surface; and measurements of the displacements show that a state of strain must have existed before actual rupture took place, but give no indication of the rate of growth of the strain. The commonly-accepted notion that the growth must be very slow appears to depend on the assumption that the strain is due to the same causes as those that have produced the folding and faulting of the surface-rocks, and also on the assumption that tectonic, as other geological processes, must necessarily be slow. The problem can only be attacked through the variation in the frequency of earthquakes; the precautions needed in applying this method are indicated, and, when applied, leave only one existing record available, the Italian one. A discussion of this shows that the rate of growth of strain is, at slowest, such that the breaking-point will, on the average, be reached in, at most, a year, and, at the quickest, may be of such rapidity as to be analogous to a separate explosion for each earthquake. The possibility of so rapid a growth of strain being due to tectonic processes, as ordinarily understood, is considered and rejected, so that the changes by which the strain is produced must be referred to the material below the crust. Recent researches on the change of bulk, resulting from a change in the mineral

ferred to as indicating one means by which the required effect may be brought about; and, without restricting the possibilities of other unknown processes, the results are summarised as indicating that the cause of the great majority of earthquakes is a rapid growth of strain, and that the production of this strain must be referred to changes which take place in the material underlying the outer crust of solid rock, which is directly accessible to geological observation.

THE INSTITUTION OF ELECTRICAL ENGINEERS

MEETINGS—SUPPLEMENTARY INFORMATION. —*Thursday, 23rd March,* 1922 (6 *p.m.*) *Discussion on the draft B.E.S.A. Specifications for Motor Starters.*

Immediately after the conclusion of the Special General Meeting of Corporate Members to be held on the 23rd inst., to make Bye-laws for the Chartered Institution, the discussion on the draft Motor Starter Specifications of the B.E.S.A. (which was begun at the meeting held on the 2nd inst.) will be continued.

A limited number of copies of the draft Specifications may be obtained from the Secretary, who will also be glad to receive the names of those desirous of taking part in the discussion.

Thursday, 30th March, 1922 (6 *p.m.*): Paper by Mr. R. Borlase Matthews on "Applications of Electricity to Agriculture." This paper will be illustrated by a cinematograph film.

Thursday, 18th May, 1922 (6 *p.m.*): The Thirteenth Kelvin Lecture by Professor Sir Ernest Rutherford, K.B.E., F.R.R., on "Electricity and Matter." Attention is drawn to the change of date (18th May, instead of 11th May).

ROYAL INSTITUTION OF GREAT BRITAIN.—*Albemarle Street, Piccadilly, W.*1.—The Friday evening Discourse next week (March 24, at 9 o'clock), will be delivered by Professor F. G. Donnan, C.B.E., D.Sc., F.R.S., M.R.I. The subject is "Auxiliary International Languages." Saturday, March 25: Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.R.I., Professor of Natural Philosophy, R.I., on "Radioactivity." (Lecture IV.)

ROYAL SOCIETY OF ARTS.—*John Street, Adelphi, London, W.C.*2.—The second Canton Lecture on the Constituents of Essential Oils, by L. Guy Radcliffe, M.Sc.Tech., F.I.C., will be given on March 27, at 8 o'clock.

The subject will be: The Classification of the Constituents of Essential Oils. The Cyclic and Olefinic Terpenes and their more important Derivatives.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

SUMMER MEETING AT SCOTTISH CENTRE, 30 MAY—2 JUNE, 1922.

A Summer Meeting of the Institution will be held at the Scottish Centre during the above period.

Ladies are cordially invited to take part in the Meeting.

The programme is substantially the same as that of the Meeting arranged for last year (abandoned on account of the coal strike), and is as follows:—

TUESDAY, 30TH MAY.—Morning: Visit to *Dalmarnock Generating Station, preceded* by a paper (at the Royal Technical College) by Mr. R. B. Mitchell, on the Dalmarnock Generating Station. Lunch at Municipal Buildings by invitation of the Corporation of Glasgow. Afternoon: Visits to John Brown & Co., Ltd., shipyard, Clydebank, the Clydes Mill Power Station of the Clyde Valley Electrical Power Co., and to other works, and a circular excursion by road to some of the Glasgow Corporation Reservoirs. Evening: Reception at the Municipal Buildings by the Corporation of Glasgow. Dance (Evening dress).

WEDNESDAY, 31ST MAY.—Morning: Paper at Glasgow University by Professor Mangus Maclean on "The Hydro-Electric Resources of the Scottish Highlands." Afternoon: Visit to Messrs. Babcock & Wilcox's Works, Renfrew. Afternoon and evening steamer excursion on Firth of Clyde by invitation of Messrs. Babcock & Wilcox.

THURSDAY, 1ST JUNE (West Highland Excursion).—Morning: Leave Glasgow for Fort William at 10.30 a.m. by special train; break journey at Tulloch Station (where picnic lunch will be provided) to view source of supply, Lochaber Waterpower Scheme. Arrive at Fort William evening and sleep there.

FRIDAY, 2ND JUNE (West Highland Excursion).—Morning: Special steamer to Kinlochleven, arriving about mid-day. Visit to the British Aluminium Company's Hydro-Electric Installation. Afternoon: Return by steamer to Oban. Hotel at Oban. End of Meeting.

CHEMICAL NOTICES FROM FOREIGN SOURCES

ROLE OF GASEOUS IMPURITIES IN THE CATALYTIC OXIDATION OF GASEOUS AMMONIA: INFLUENCE OF PHOSPHORETTED HYDROGEN—*E. Decarrière.*—The author has already shown that acetylene and sulphuretted hydrogen retard the catalytic oxidation of ammonia in presence of platinum. He has further found that even the minutest traces of phosphoretted hydrogen act as a poison, and .00002 per cent. of PH_3 is almost as toxic as 2 per cent. of H_2S. But as with H_2S the lowering of the yield only lasts as long as the impurity is present, which is not the case with C_2H_2.—(*Comptes Rendus, CLXXIV.*, No. 7, 1922).

MIXED ORGANO-METALLIC COMPOUND OF ALUMINIUM—*V. Thomas.*—When aluminium is left for a long time in contact with methylene iodide in the absence of any solvent, a reaction occurs without liberation of any gas, and a white crystalline substance is obtained which very readily reacts with most reagents. With nitrobenzene it is very rapidly decomposed, and iodine vapour is given off. When the reaction occurs in presence of anhydrous ether, it is found that approximately one atom of aluminium reacts with one molecule of methylene iodide. When about 1.5 gr. of the metal and 12 gr. of the iodide are brought together, about 90 cc. of a gas are evolved. This gas is absorbed by bromine and attacked by permanganate, and its formula is $(CH_2)_n$, but it cannot be identified with ethylene. By combustion in a cudiometer it is found that n is about equal to 3. The compound obtained in presence of ether is very active chemically, and reacts with acetyl chloride with evolution of much heat. It appears that other metals besides aluminium, for example lead, can attack methylene iodide in absence of any solvent, with evolution of considerable quantities of gas.—(*Comptes Rendus CLXXIV.*, No. 7, 1922).

NEW METHOD OF PREPARING CYCLIC AMINES—*Alphonse Mailke.*—When aniline is directly hydrogenated over divided nickel a mixture of three amines is obtained, cyclohexylamine, dicyclohexylamine, and cyclohexylaniline. Metatoluidine is hydrogenated less easily, three distinct products, one of which is hexahydrometatoluidine, being obtained. The author has found that the hydrogenation of the three methylcyclohexanoneoximes over nickel gives mixtures of primary and secondary amines, but the yield is low owing to the occurrence of secondary reactions. He has also prepared the cyclic amines by the hydrogenation of the ketazines and of cyclic ketones, for example, orthomethylcyclohexylamine and metamethylcyclohexylamine. The yields of the primary amines obtained by this method are much higher than those of the second, ary amines.—(*Comptes Rendus, CLXXIV.*, No. 7, 1922).

PREPARATION OF FATTY ACIDS FROM HYDROCARBONS—*M. E. Defrance.*—Oleic acid has been synthesised starting with acetylene, the hydratation of which gives aldehyde, from which a mixture of alcohols of high molecular weight is obtained by a series of condensations. These alcohols can be converted into the corresponding acids by oxidation. It does not appear probable that these processes can ever be applied on a large scale. By the method of Zelinsky, the paraffins can be converted into acids; they must first be chlorinated in the α position, and the chloride thus obtained is subjected to Grignard's reaction. The action of CO_2 upon the organometallic derivative thus formed leads directly to the formation of the acid. This method is also a laboratory method only, and is not likely to be extended to commercial applications. The hydrocarbons can be directly oxidised by means of ozone, but this is very expensive to make. There are many problems to be solved with reference to the oxidation of the paraffins. For example, very great differences of yield are obtained, and no precise information is to be obtained as to the occurrence of particular hydrocarbons in the different fractions of the mineral oils. The special reactions of each of these hydrocarbons are hardly known, and no studies have been made as to the influence of various factors—pressure, temperature, catalysts, alkalinity, etc., in the oxidation of each compound. The synthetic fats can be prepared by the etherification of the fatty acids with glycerine, but the great variety of the mixture which constitute the natural fats makes it very difficult to reproduce them artificially. Lapworth has recently prepared a dioleate of mannite, and it is possible that fats of physiological importance may be similarly obtained.—(*Journ. de Pharmacie de Belgique, IV.*, 1922, No. 10).

NOTES ON BOOKS.

A Textbook of Assaying for the use of those connected with mines, by C. & J. J. BERINGER, revised by H. R. BERINGER, with diagrams and tables. 15th edition revised. xvi. plus 417 pp. CHARLES GRIFFIN & Co., LTD., Exeter St., Strand. Price 12/6.

The fact that 15 editions of the above work have appeared since its first publication in 1889 shows that it has been appreciated among students and those engaged in metallurgy. The work deals very exhaustively with the subject, presenting it in such a way as to meet the requirements of the student. The operations of sampling, choice of laboratory books, determination of moisture and similar matters, are treated in an introduction, which is followed by a good description of the dry and wet methods of assaying. The first 8 chapters deal with methods of manipulation, and in Part 2, Chap. 9, the detection and assay of silver and gold are given in detail.

The description of the metallurgy of Titanium, Tungsten, Niobium and Tantalum has been brought up to date, and a chapter is devoted to the alkaline earths. The six appendices that have been introduced into the various editions have been included. The book is thoroughly well illustrated, and will undoubtedly remain as a standard textbook on the subject for some time to come.

It is not possible to refer in detail to the mass of information included in the work.

We cannot help thinking, however, that some of the sections, particularly that referring to the alkaline earths, are still in need of revision. For instance, the extremely important oxide Thoria is very briefly touched upon, and nothing is said about its value as a means of illumination, while the next earth referred to, Zirconia, is said to be used for incandescent lights. Although this, of course, is perfectly correct, the importance of zirconia as an illuminant is insignificant as compared with that of thoria. Also the paragraph dealing with Lanthanum and Didymium seems a little out of date, as the latter body is described as though it were an elementary substance, no reference being made to its resolution into praseo- and neo-dymium by Auer von Wellsbach in 1880.

The Failure of Metals under Internal and prolonged stress.—A general discussion held by the Faraday and other societies in April, 1921, at the Hall of the Institution of Engineers.

Following the official business of the meeting, the President of the Faraday Society, Professor Alfred W. Porter, F.R.S., called upon Dr. W. Rosenhain to give his introductory address upon the failure of metals under internal and prolonged stress. Dr. Rosenhain, whose work upon this and kindred subjects is very well known, dealt exhaustively with the matter, and illustrated his remarks by a number of photomicrographs, some of which are reproduced. A number of papers were contributed, both of a general character and of specific cases of failure in steel and brass. The papers were followed by important general discussions, which are given in detail. The work is edited by Mr. Spiers, O.B.E., B.Sc., and is illustrated by many photographic reproductions. It cannot fail to be of value to all interested in metallurgical operations.

The Report, in book form, bound in cloth, is published by the Faraday Society, Essex Street, London, W.C. Price 10/6 net.

A Course of Practical Organic Chemistry, by T. SLATER PRICE, O.B.E., D.Sc., Ph.D., F.I.C., and DOUGLAS F. TWISS, D.Sc., F.I.C.: pp. xiv plus 239. London: LONGMANS, GREEN & Co., 1922. Price 6/6.

This textbook of practical organic chemistry has now reached its 3rd edition. The subject matter includes directions for the preparation of typical organic compounds, experiments to be carried out illustrating the properties of these, schemes for qualitative analysis, and the usual methods of quantitative analysis and determinations of molecular weight and formulæ are described.

This edition contains few alterations from the last, the most important being that the Grignard reaction is utilised to prepare benzoic acid, instead of the less well-known benzhydrol.

Two schemes of qualitative analysis are given. The first one appears at the end of the section on Aliphatic Compounds, and is suitable for the identification of about 40 substances and their derivatives.

The second scheme can be used for iden-

tifying the common aromatic bodies and their derivatives as well as for the aliphatic substances previously mentioned.

The chapters dealing with quantitative estimations are the best feature of the book. They are clearly written, and students will experience little difficulty in following the instructions given.

Except for the arrangement there is little that has not appeared previously in other textbooks on this subject.

The authors would greatly add to the value of this book if, in the next edition, they extensively alter the particular substances selected for the preparation of typical organic compounds.

Laboratory Exercises in Applied Chemistry, by Dr. W. MOLDENHAUER. Authorised Translation by LAWRENCE BRADSHAW, D.Sc., Ph.D.; pp. xii. plus 236. London: CONSTABLE & Co., LTD., 1921.

Dr. Moldenhauer's book has been written for students who are following a course of technical analysis. It comprises practically all the exercises conducted at the Darmstadt Technical College.

The translator has omitted most matter of purely local interest, but wisely retains the chapter dealing with the analysis of the crude and refined products from the Stassfurt Potash Mines.

Most of the analytical methods are well known, but a few are not those usually taught in our technical colleges and institutes. Among these is Ledebur's method for estimating phosphorus (page 157) and the apparatus figured on page 215 for the determination of the flash point of an oil has been considerably improved upon in this country.

In technical analysis, the rapidity with which a determination can be made is the prime factor. Consequently volumetric methods are chosen wherever possible, when they give sufficiently accurate results. The author evidently has this in his mind, since he even includes among these, Müller's Benzidine hydrochloride method for the estimation of sulphuric acid, present in salts as neutral sulphate.

An error has crept in on page 171, where brass is described as an alloy of zinc and tin.

The book can be safely recommended to the students for whom it is written.

Aluminium and its Alloys, by LT.-COL. C. GRARD. Translated by C. M. PHILLIPS, B.A. (Cantab), A.I.C.; pp. xxiv. plus 184 plus 17 plates. London: CONSTABLE & Co., LTD., 1921. Price 17/6 net.

Col. Grard has written this volume from the aeronautical viewpoint. Consequently he confines himself to the metallurgical and mechanical studies of aluminium and its alloys, with special reference to their industrial applications.

Much useful information has been collected, chiefly from French sources, which is of interest to physicists and to those engaged in various branches of engineering. The mechanical properties of the metal and its principal alloys are fully treated. Numerous photo-micrographs illustrate the effects of various treatments, such as cold-working, annealing, forging, etc. All this is of considerable importance, since, as the author shows, such treatments cause great variations in mechanical properties, such as tensile strength, elasticity, shock resistance, and hardness.

"Duralumin," the light alloy of great strength, contains from 3.5 to 4 per cent. of copper, and is obtained in the optimum final state by double quenching, showing maximum tensile strength, elasticity and percentage elongation.

Various magnalium alloys containing from 5 to 25 per cent. of magnesium show increased hardness, but are difficult to roll. It is of interest to note that parts of the Zeppelin brought down at Bourbonne were made of similar material of density 1.8.

The appendices retained by the translators contain analytical notes; extracts from French Aeronautical Specifications; and Reports of Tests conducted in certain French Technical Laboratories.

The book should be read by all concerned with the industrial applications of this metal.

Atomic Theories, by F. H. LORING; pp. x. plus 218. London: METHUEN & Co., LTD., 1921. Price 12/6 net.

The last decade of the nineteenth century witnessed the beginning of extensive experimental work and theoretical deductions in connection with the Structure of the Atom.

Mr. Loring has performed the difficult task of collecting and correlating the main conclusions arrived at from the numerous researches and speculations of many distin-

guished physicists and chemists. He has obtained his material from the original communications scattered among the various periodicals and journals of scientific societies, and includes some of his own contributions in the *Chemical News*. The most recent work has been incorporated in the book which is thus thoroughly up to date.

An adequate account is given of each of the numerous theories regarding the structure and nature of the atom. Wherever necessary the author has preceded the discussion of a theory by introductory notes bearing upon the significance of the experimental evidence. This is invaluable for students and those who are not thoroughly acquainted with the recent rapid strides of physics and physical chemistry in the realms of X-ray analysis, crystal-structure, radio-active disintegration, etc.

Rutherford's Nuclear Theory of the Atom together with the experimental evidence on which it is based is given prominence.

Laugmuir's Octet Theory of Valence has received much attention since it was advanced three years ago, and his views on the arrangement of the electrons in the atom are quoted and merit careful consideration. Mr. Loring also deals with Sir J. J. Thomson's views on matter, mass and radiation, and with Aston's work on the mass spetra of atoms.

That the author has experienced difficulty in arranging the subject is evidenced by the fact that no less than eight appendices are given. Although most of these are mathematical and statistical, one is devoted to the Rutherford-Boddy Disintegration Law, and another to a useful explanation of the exact nature of the molecule.

Altogether this account of the recent experimental and theoretical investigations on the atom should appeal, not only to students of physics and chemistry, but also to those engaged in the various branches of mechanics and engineering. It can be confidently reommended to all interested in this important subject.

ROYAL INSTITUTION. — On Thursday (March 30) Professor A. M. Hind delivers the first of two lectures on "Landscape Etchers: New and Old." The Friday Evening Discourse on March 31st will be delivered by Mr. A. B. Walkley, on "Jane Austen"; and on April 7, by Sir Ernest Rutherford, on the "Evolution of the

GENERAL NOTES.

The *Manchester Guardian Commercial* recently contained an important article on paper-making, in which Mr. Frederick Kaye, the discoverer of the rubber latex process, discusses the possibilities of the new methods:—"By using very strong fibres, such as Manila Hemp, Sisal Hemp, Jute, etc., and using higher percentages of rubber, say, up to 20 per cent. and more, products can be made on the paper-making machine to take the place of leather for many purposes. Such products can, necessary, be vulcanised by any suitable method. By using mechanical wood, waste paper, and various other fibres, with loading materials, and increasing the quantity of rubber latex used, linoleum-like products can be cheaply and abundantly made on a paper-making machine. These goods will be waterproof and very resisting to abrasions due to constant hard wear. By mechanical devices now being perfected, it will be possible to make these goods with beautifully coloured designs inlaid in the materials. Experiments show that many kinds of asbestos goods now made from Asbestos, such as high-pressure packing, can be made by the use of rubber latex. The latices of kutta-percha and balata can be used in the manufacture of paper and other goods to contain these natural products for the specific purposes for which their properties make them so valuable. Experiments on a commercial scale have already been conducted successfully in paper mills, and arrangements have been made for further commercial tests as to the production of latex paper in different paper mills in Lancashire, Yorkshire, the Midlands, London and the South. When these have been proved satisfactory, arrangements will be made to import larger supplies of latex for the use in the paper industry."

MORPHIA LICENCES.—Mr. Short, the Home Secretary, in reply to a question, said that the form of licence issued under the Dangerous Drugs Act, 1920, permitting the manufacture of morphia in Great Britain, was an authorisation to carry on the manufacture of morphine at certain premises specified in the licence and subject to certain conditions. The conditions were not necessarily the same in each case, but, in general, they provided for adequate supervision, exclusive of unauthorised persons, keeping of records of production and

mises *licensed* was three. The amount of British-made morphia exported during 1921 as shown in the Customs returns, was 81,098 ounces, but this did not include the amount exported through the parcel post. The total amount of morphia licensed for export including export by post, was 112,681 ounces. Morphia was exported to all parts of the world, but over one-half of the amount shown in the Customs returns went to France. Other countries which received more than 5,000 ounces were Sweden, Belgium, and Canada.

Poison for Criminal Purposes.—Mr. Shortt, Home Secretary, in answer to Sir R. Clough, said he believed that the use of poison for a criminal purpose had always been of rare occurrence in this country, and notwithstanding two or three recent cases, he did not think it could be alleged that it had become commoner than it used to be. He doubted if it was possible by law to ensure that there would be no improper sales, especially in the case of poisonous substances that were commonly used for legitimate purposes, but the matter was receiving consideration.

The Science Association, Maharajah's College, Vizianagram.—We have received from Madras, India, an account of the first anniversary meeting of the above institution. The proceedings were opened by Mr. C. V. H. Row, M.A., Professor of Mathematics at Lahore. His Highness the Yuvarajah Saheb of Vizianagram was present.

The objects and work of the Association were explained by the chairman. During the session popular lectures had been given upon chemical, physical, astronomical and other subjects, and a number of original communications had been read before the Society. Among them are two by Mr. Y. Venatramaiya, upon active hydrogen and the activation of hydrogen by the silent electric discharge. One of these papers has already appeared in "Nature," but we have been asked to reproduce them both.

As the subject of active nitrogen has recently been exhaustively investigated by Lord Rayleigh, the experiments by Dr. Venkatramaiya are of considerable interest. The other papers enumerated we are unfortunately not able to reproduce.

At the conclusion of the meeting, the Yuvarajah Saheb expressed his desire to promote the pursuit of scientific knowledge and to become the patron of the Association, who would always find in him one who would be ready to help and assist in every way.

Refractories and Research. — Before the members of the Midland Junior Gas Engineers on Thursday, March 16, Mr. T. F. E. Rhead, M.Sc., chief chemist to the Birmingham Corporation Gas Dept. (Central Laboratories, Nechells Works), read a paper on the chemistry and physics of gas works refractories. As to the use of grog in brick manufacture, he pointed out that the quantity of grog that could be added was limited by the fact that it reduced the strength of the refractory. Generally speaking the best grog to be used was that made from the clay from which the article was being made, after the clay had been burned a sufficient lenfth of time to take out all the fire shrinkabe. Firebrick should be burned at a finishing temperature of not lower than Cone 14, 1410° C., or higher, but many manufacturers did not go so high owing to the increased cost of production involved by the use of more fuel. The goods should be fired at a higher temperature than that they would attain when in use. Under steaming conditions on vertical gas retorts, it was possible that the coal ash had increased opportunity of attacking retort walls, partly due to the thinner scale, and partly due to exposure of the ash as the carbon was consumed by the steam. A similar effect was obtained in water gas generators where slagging action on the refractories was a serious item. The manufacturers' difficulty was that while a close-grained texture was best for overcoming those troubles, a course-grained texture was necessary to enable the material to stand temperature changes.

Mr. Rhead added that whilst testing refractories he had been very much impressed with the variations in quality of material supposed to be of uniform grade, and the necessity of both user and maker paying far greater attention to the quality of refractories could not be too strongly urged. Seeing the extensive use the gas, metal and pottery industries made of refractories, and the serious results which occurred if they broke down, there seemed every argument ofr that suggestion being more generally adopted. The number of gas works, however, that bought their material to specification, and what was more important, see

ing that it was up to specification by carefully testing it, was decidedly small. Similarly, apart from a few enlightened manufacturers, very real testing was carried on by the makers. Central testing laboratories were needed. The variations in the quality of the raw material was much greater than was commonly recognised, and this was one factor which called for very careful watching and continuous testing and supervision on the part of the manufacturer. Well-informed technical control required to be started in the mine or quarry, just as in analysing a substance the sampling had to be most carefully and intelligently done, otherwise the result was useless. The Refractories Specification of 1911 was a big step forward, but it was very badly in need of revision in the light of knowledge and experience accumulated since then. With a revised specifiaction reasonably to meet all present day requirements, and gas engineers buying to that specification, much better or more uniform material would doubtlessly result. It was, however, only fair to add in what pretends to be an unbiassed opinion on the subject of quality of refractories, that scientific men had still a great deal to discover about refractories—but surely that showed the urgent need for increased research on the lines of the invaluable fundamental work being carried on at Stoke, Leeds, and elsewhere. There were possibilities of great advances being made in the manufacture and proper use of refractories, as well as the introduction of new ones, if the greatest possible co-operation between maker, user and physical chemist was encouraged.

EDITORIAL NOTE.

It has been decided, on account of the rapidly increasing activity in Chemical and general Science, that for the future the number of pages in the *Chemical News* shall be raised to sixteen weekly.

The change has been rendered necessary by the large amount of matter that is being offered to the Editor for publication, consisting mostly of articles of original and progressive nature, a sure sign of the resumption of activity that was to be expected as soon as the war disruption had passed.

There is no doubt about the increase of work in the domain of Chemistry and Physics during the past few months, and everything points to better times in the near future.

THE APPLICATION OF THE PRINCIPLES OF EFFICIENCY TO THE TEACHING OF CHEMISTRY.

By J. Norman Taylor.
George Washington University.

Reprinted from School Science and Mathematics, December issue, 1921, Vol. XXI., No. 9.
By Favour of the Author.

The principles of efficiency find immediate and valuable application in all walks of life. This short paper will be confined to an outline of them, touching upon each one as applied to chemistry teaching, but not attempting a detailed discussion.

In reading the "Study of Engineering Education" by Dr. Charles Riborg Mann [1] one is struck by his statement that "Efficiency in the mastery of materials without human intelligence to guide and control it is now recognised in all civilised countries as a curse."

Complete and true efficiency is material only in its application, and is fundamentally ethical or moral in its nature. Individuals, or groups of individuals, who do not realise and demonstrate the truth that it is servant and not master are attempting to operate against natural laws. That efficiency in the mastery of materials must be guided by common sense and morality, and that mechanical efficiency must be subordinated, offers an opportunity, says Dr. Mann, to the humanistic studies. "This has already been perceived at a number of schools, and many efforts are being made to alter the content of the courses in English, in history, and in economics to meet the obvious need."

Although efficiency cannot be defined very accurately because of its many phases and manifestations, the definition given by Harrington Emerson is comprehensive and satisfying. Personal efficiency, he states to be "mental and physical ability to find and take the best, easiest and quickest ways to the desirable things of life."

Can not we apply to the development of intelligence and to the efforts of the teacher the methods of the industrial and business world which have contributed so largely to its success?

Sir Robert Blair, in his opening address

1 Carnegie Foundation for the Advancement of Teaching, Bulletin 11, 1918
2 Nature, November 4, 1920, P. 323.

as President of Section L (Educational Science) delivered at the Cardiff meeting of the British Association for the Advancement of Science, made clear that a valuable aid to education is the inculcation of the teaching profession with the scientific spirit. "Matter taught and teaching methods are no longer exclusively determined by mere tradition or mere opinion." "Education as a science should be something more than mere applied psychology. It must be built up not of the speculations of theorists, or from the deductions of psychologists, but by direct, definite *ad hoc* inquiries concentrated upon the problems of the class room by teachers themselves."

No attempt will be made here to detail the subject matter of chemistry courses or its method of presentation. It will be sufficient to outline the principles which have been set forth by Mr. Emerson,[*] and under each of these to mention its application to the teaching of chemistry, together with some practical suggestions as to its application.

The principles, which may be set down as thirteen in number according to Mr. Emerson's latest classification, are divided into seven practical and six ethical ones. It will be seen that they are independent and at the same time interdependent:

The Seven Practical Principles:

1. Records.
2. Plans
3. Schedules.
4. Despatching.
5. Standardised Conditions.
6. Standardised Operations.
7. Written Standard Practice Instructions.

The Six Ethical Principles:

1. Ideals.
2. Common Sense.
3. Competent Counsel.
4. Discipline.
5. Fair Deal.
6. Efficiency Reward.

In the application of any one, or all, of these principles, it will be necessary at the outset to establish standards. In order to carry on any part of the teaching of chemistry and in fact all parts, we make use of standards, and about the first thing that is necessary to be done is to set a standard for ourselves and for the pupils regarding how to study. For the individual teacher this may be accomplished much more easily than for the pupils. It is only after a large number of trials that standards can be established which will apply to a large group of individuals.

RECORDS.

In order to establish standards which will be just, "recourse must be made to records and they must be immediate, reliable, adequate and permanent." Convenient types of record cards are those put out by the Rand Company and by the Library Bureau. Paste board transfer cases may be used in place of the more expensive cabinets. Cheap paper stock may be cut up and used in place of heavy card stock.

Records are indispensable in determining amounts of chemicals and apparatus on hand in the laboratory as well as in the selection of the best place from which to order. Records measure progress and show its direction, and as examples we have the student's note book and the instructor's record of quizzes. The quiz record, however, may not be only of value in determining grades, but it may also "warn of wrong methods, unwise procedure, and inefficient operations." It also grades the teacher's efficiency. Records are of great value as a basis f· future work.

PLANS.

Records, therefore, are useful in making plans—one of the most important of the thirteen principles. Through their consultation the instructor is enabled to plan the scope and order of the work for the year, to find out how best to allot his supply of time for laboratory and lecture work, and to plan what detail to assign to his assistants.

In planning for the best method of presentation of the subject, he may find, upon consulting his records of quizzes and of recitations, and upon comparing them with with the grades evidenced from examination of the laboratory note books, that the best method is through the laboratory. Or, he may find that for a particular class the lecture table demonstration method or the project method is the most efficient. Or, that the lecture-demonstration-conversation method excels all of these. If he keeps a record of the ratings in "chemistry exercises" or study questions worked out by

Instruction by the informal recitation method has been successfully applied by

* Emerson, Harrington. "The Twelve Principles of Efficiency," 5th Ed., Engineering Magazine Co., New York, 1917.

Professor Karsner [4] to medical education. The method will undoubtedly prove applicable as a means of teaching some parts of chemistry.

Through consulting records the instructor can plan for equipment. Knowing through his records the *amount of time supply* available, he can plan for time in which to study and to keep abreast of the developments in the science. He can plan for recreation to maintain his health and permit of the greatest force and usefulness.

[4] Karsner, Howard T., "'Progressive Education' in the Teaching of Pathology," Science, July 29, 1921, pp. 81-84.

BOOKS RECEIVED.

Alchemy: Ancient and Modern, H. Stanley Redgrove, B.Sc. (Lond.), F.C.S. Pages: xx. + 141. Messrs. William Rider & Son, Ltd., 8, Paternoster Row, E.C.4. Second Edition, 1922. Price: 7/6 net.

An Introduction to the Analytical Chemistry of the Rarer Elements, by Louis J. Curtman. Pages: iv. + 64. 1922.

THE CHEMICAL SOCIETY—ANNUAL GENERAL MEETING.

The Annual General Meeting will be held at Burlington House, Piccadilly, W.1, on Thursday, March 30th, 1922, at 4.30 p.m., when the President, Sir James Walker, D.Sc., F.R.S., will deliver his Address.

An Informal Meeting will be held the same evening at 8 p.m.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

5050—Boehringer Sohn, C. H.—Process for preparation of papaverine nitrite. Feb. 21.

566—Chapman, D. L.—Method of chlorinating hydrocarbons and their derivatives. Feb. 25.

5340—Chemical Engineering Co. — Recovery of valuable products from pips of locust beans, etc. Feb. 23.

931—Farbenfabriken vorm, F.—Process for manufacture of hyposulphites. Feb. 20.

5214—Hirchberg, L. M.—Production of formaldehyde by catalysis. Feb. 22.

5118—Rambush, N. E.—Manufacture of producer gas with recovery of by-products. Feb. 21.

Specifications Published this Week.

158863—Nitrogen Corporation.—Method of producing sodium bicarbonate and hydrogen.

175006—Wolcott, E. R.—Process for producing aluminium chloride.

175019—British Dyestuffs Corporation. Manufacture of ortho-sulphonic acids of aromatic amines.

175077—British Cellulose and Chemical Manufacturing Co., Ltd.—Manufacture of dialkylsulphates.

155781—Spitz, W.—Process for the manufacture of preparations of calcium iodide fit for therapeutic purposes.

157226—Farbwerke vorm. Meister, Lucius & Bruning.—Manufacture of a complex aurothiosalicyclic acid.

Depilating Hides.—Patent No. 173,788.—A new chemical process of unhairing hides has been invented by T. B. Carmicheal, of 12, Birchdale Rd., Waterloo, Liverpool, and Ockleston, W. H., of Eddisbury Lodge, Kelsall, Chester.

The hides and skins are treated with sodium sulphide and caustic soda, and consists in the use of these substances in successive and very weak solutions of a strength of approximately one-half per cent. Dry hides are preferably first softened in a 0.3 per cent. sodium sulphide solution, being then treated in a 0.5 per cent. solution, followed by treatment in a 0.5 per cent. solution of caustic soda. In an example, three pits or drums are employed, containing respectively 30, 56, and 52lb. of material to 1,000 gallons of water, the liquors being replenished for each batch of hides and fresh liquor prepared at intervals, the depleted second sulphide bath being used for the preliminary soaking when the first bath is renewed for use as the second bath.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on, post free, for the official price of 1s. each.

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

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J. BUTEUX SKEGGS.
Town Clerk.

Council Offices, High Street, Poplar,
E.14

10th March, 1922.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3233.

SCIENCE HONOURS MADAME CURIE AT THE AMERICAN MUSEUM.*

The New York Academy of Sciences, the American Museum of Natural History, and the New York Mineralogical Club, recently united to do honour to Madame Marie Curie, "a lady whose name," to use the words of Dr. George F. Kunz, who presided on the occasion, "will live long, long after those who have aspired to fame ostentatiously or otherwise, will all have passed away."

Two testimonials were presented to the discoverer of radium—the one a certificate signalising her election as an Honorary Fellow of the American Museum of Natural History, the other conferring upon her Honorary Membership in the New York Mineralogical Club. In bestowing the former, President Osborn said:—

"My pleasant duty to-night is to extend the hospitality of the *American Museum of Natural History* to Madame Curie, and to announce that, by unanimous vote of the scientific staff, and unanimous vote of the trustees of this institution, we have elected Madame Curie an Honorary Fellow of the American Museum of Natural History. I have in my hand the certificate of membership, and I would present this certificate to Madame Curie with the statement that she is the first woman to receive this honour; that it is given in recognition of her great discovery in the fields of physics, of mineralogy, and of chemistry; and that we give it with the greatest enthusiasm because of the fundamental character of her discoveries in these fields.

"Madame Curie, may I greet you as an Honorary Fellow of the American Museum *of Natural History?*"

In presenting the certificate of honorary membership in the New York Mineralogical Club, a ceremony which took place toward the close of the evening, Professor Phillips spoke as follows:—

"The New York Mineralogical Club, by unanimous vote, at the annual meeting of the organisation, on the evening of April 20, 1921, at the American Museum of Natural History, desiring to express its fullest appreciation of Madame Curie and her transcendant service to humanity through the discovery of radium in the year 1898, and many great contributions to radial knowledge since, hereby confers Honorary Membership, with life tenure appended thereto.

"It gives me great pleasure to present this, Madame Curie, and the three organisations that arranged this meeting are here to honour you, Madame Curie, and to show their appreciation of your great services to humanity."

Madame Curie, in reply, said:—

"I am very grateful to the New York Academy of Sciences, the New York Mineralogical Club, and the American Museum of Natural History, for this beautiful reception and for the recognition of my work.

"I cannot say how happy I am that I was permitted to be the discoverer of radium; but I would like to remind you of the names which are associated with this, of which you know many—as Sir William Ramsay, Berthelot, Rutherford, Soddy, Becquerel, Abbe, etc.

"Then I would like to say how deeply I am moved by the beautiful progress of the medical application of radium, of which you have just now heard from Doctor Abbe, and we must remember that the success of that is due, not only to the discovery itself, but also to the splendid efforts of distinguished specialists which were made and especially by Doctor Abbe, and we must be thankful to all of them, just the same as to the discoverer."

* Abridged account of the proceedings at the American Museum, by favour of Dr. George F. Kunz.

The Calcutta Pottery Works affords an outstanding instance of modern Indian enterprise in the establishment and development of an important industry. In an article contributed to the February number of the *Journal of Indian Industries and Labour*, Mr. S. S. Deb gives an interesting account of these works, illustrated by three excellent photographs, with a brief resumé of the methods and progress of the art of ceramics in India up to the present day. India has not to look outside her own territories for the raw material necessary to this industry, which has a great future before it provided that it is conducted along the right lines. The Calcutta Pottery Works sets an example worthy of emulation.

REACTIONS BETWEEN THE HIGHER FATTY ACIDS AND SALTS OF THE LOWER FATTY ACIDS.

(By Arthur W. Knapp and Raymond V. Wadsworth).

This investigation resulted from our discovery of the following fact:—

If finely powdered sodium acetate is added to *oils*, or *melted* fats, a *jelly* or gelatinous precipitate is generally produced.

The dried salt gives more, and the anhydrous salt most jelly. Sodium propionate and sodium butyrate produce similar results. Jellies occupying from one-third to *eight-ninths of the volume of the oil were* obtained by warming 5 per cent. of the anhydrous *sodium acetate with oils consisting* mainly of different characteristic glycerides, such as linseed oil, coconut "stearine," cacao-butter and olive oil (the oils contained from 0.5 to 2.5 per cent. of oleic acid 1.2 per cent.) gave no jelly. This characteristic action of castor oil has not been further investigated. It would appear either that ricinoleic acid does not decompose the acetate, or if it does, that the soap formed remains in solution.

If the oils are washed with alcohol so as to free them from fatty acids, no jelly is obtained with acetate. That the acetate does not react with the glycerides is also shown by the fact that no acetin is formed. Pure *glycerides do not react with sodium* acetate, but samples of the following glycerics, which had been prepared six years and hence were slightly decomposed, gave gelatinous precipitates:—

tributyrin	trilaurin	trimyristin
tripalmitin	tristearin	triolein

The jellies so obtained are soaps, formed by the interaction of sodium acetate and the free fatty acids. We have here the basis for a new method of removing fatty acids from fats which might prove to have important technical applications.

Action of Salts with Fatty Acids.—It is well known with regard to the fatty acids that the greater the molecular weight the weaker the acid. This is stated to be well shown, for example, by the marked decrease in the heat of neutralisation. But we find that if the higher fatty acids be put in presence of the salts of the lower fatty acids, the weaker drives out the stronger. *The first cause of this reaction is that the* salts are soluble in the acids; whereas the soaps form only colloidal solutions. On applying heat, the reaction proceeds because *the stronger acids are the more volatile*, and hence in this respect the action is analogous to the action of sulphuric acid on sodium chloride. Thus if sodium acetate is added to liquid stearic acid, the odour of acetic acid is perceived, and if the mixture is heated to 110° C. for some hours so that the acetic acid can escape, the action continues to completion, and pure sodium stearate remains. A similar reaction takes place with palmitic, myristic, lauric, and even caproic acid. From the fatty acid and salt a clear solution can be obtained which appears to be a colloidal solution of the soap. This is best observed with oleic acid, which acts in the same way as the saturated acids. Sodium acetate is soluble in oleic acid at 30° C., and is crystallised out from solution at about 22° C. At 40° C. about 10 per cent. can be dissolved. As son as the sodium acetate is dissolved the oleic acid becomes more viscous. At 100° C. molecular proportions o foleic acid and sodium acetate give a clear solution. On cooling, this becomes a very thick jelly. Contrary to expectation we find that when either stearic or oleic acid is mixed with an equivalent proportion of sodium acetate, heat is given out.

If the fatty acid, *e.g.*, stearic acid, is dissolved in absolute alcohol and the acetate added, a gelatinous precipitate of soap is formed almost immediately. If water is now added, the reaction is reversed and we obtain the orginal fatty acid and sodium acetate.

Colloidal Soaps in Oils.—If one per cent. of sodium acetate, propionate, butyrate, caproate, myristate, laurate, palmitate, stearate or oleate be added to an ordinary fat or oil (containing as usual free fatty acids) and warmed, a jelly or gelatinous precipitate (*which in time settles towards the* bottom of the vessel, forming a denser and more visible mass) will be formed in the case of the salts of the *lower* fatty acids. This is due to the reaction we have described above. With the salts of the *higher* fatty acids a certain amount of the salt or

soap goes into solution, but precipitates on cooling as a gelatinous mass. This is only clearly shown when a large percentage of fatty acids or olein, in which the soaps are soluble, is present. Sodium formate differs from the other salts, in that it is a salt of a much stronger acid, and its solubility in fatty acids is very low; consequently it does not give a jelly with olive oil, and only very slowly reacts with the higher fatty acids to form soaps.

All the jellies are formed most readily in the complete absence of water. They can be obtained as solutions in olive oil (which is rich in olein) by warming and filtering at 100° C. The soaps, under these conditions, are reversible colloids. On cooling, the jelly is usually slowly deposited as a mass of minute globules.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MARCH 16, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

H. H. DALE, M.D., F.R.S., and C. H. KELLAWAY. Anaphylaxis and Anaphylatoxins.

The paper deals with the two main theories put forward to explain anaphylaxis to a soluble foreign protein: (1) the theory of cellular antibody, and (2) that of anaphylatoxin. New evidence is produced in favour of (1).

A purified, concentrated precipitin for crystallised egg-albumin was prepared, and a control preparation was made of similarly concentrated globulin from normal rabbit's serum. Guinea-pigs were rendered passively anaphylactic to egg-albumin by an injection, two days previously, of the precipitin. Intravenous injection of a further dose of the same precipitin, given a few minutes before a dose of egg-albumin, suppressed the anaphylactic reaction completely; normal rabbit globulin showed no trace of such protective action.

Similarly, isolated plain muscle from anaphylactic guinea-pigs suspended in saline solution, was completely protected from the stimulating effect of egg-albumin by adding to the bath the precipitin which caused the anaphylactic condition; normal globulin had no protective action.

The nature of so-called "anaphylatoxins," produced by digesting serum with carbohydrate sols, etc., has been examined. Evidence is produced that their toxicity is due, not to protein cleavage, but to formation of complexes which keep the foreign colloid finely dispersed in the finished product.

The anaphylatoxins produce symptoms which are not identical with those of true anaphylactic shock, and they do not act on isolated plain muscle, as the anaphylactic antigen does, but only exhibit their action in the presence of the circulating blood. Their action is attributed to exposure of the blood to a large foreig nsurface. One dose of anaphylatoxin renders an animal insensitive to another, but leaves it, if anaphylactic, sensitive to the antigen.

Conclusions are drawn in favour of (1) and adverse to (2).

J. G. BRAMWELL and PROF. A. V HILL, F.R.S. *The Velocity of the Pulse Wave in Man.*

The velocity of the pulse wave, relative to the blood in the vessel, is given in metres per second, by

$v = 3.57 / \sqrt{\text{percentage increase in volume of vessel per mm. of Hg. increase of pressure.}}$

An observation of the velocity, therefore, gives the degree of extensibility of the vessel, and is one criterion of an efficient circulation.

The experiments of Roy (1880) on the extensibility of blood-vessels may be used to calculate the velocity of the pulse wave; the calculation shows: (*a*) that pressure has a considerable effect on the velocity, a fact which is confirmed by experiments on an isolated human artery, filled with mercury to slow the transmission of the wave; and (*b*) that the velocity so calculated is less than that observed in man, a fact which is attributed to the "elastic after-action" which affected Roy's measurements. Experiments on an isolated human artery gave a velocity comparable with that observed in man.

It is concluded that the transmission of the pulse wave is a purely mechanical effect, its velocity depending on the extensibility of the vessels as modified by any condition (muscular or otherwise) pertaining at the moment.

ALEXANDER FLEMING, M.B. On a New Bacteriolytic Element found in Tissues and Secretions. Communicated by Sir Almroth Wright, F.R.S.

A substance has been found in tissues and secretions which is strongly bacterio-inhibitory, bactericidal, and bacteriolytic. This substance has been called a "microzyme."

A coccus (*Micrococcus lyticus*) appeared in cultures made from the nasal mucus of a patent suffering from acute coryza. This coccus has been found to be particularly susceptible to the action of a microzyme, and has been used an an indicator in experiments on its properties and distribution.

Microzyme is precipitated from albuminous solutions by protein precipitants; it is very susceptible to small changes in the reaction of the fluid, being inhibited by 1/800 normal acid or alkali; it will not pass through a collodio nmembrane; filters of porcelain, cotton wool or filter paper absorb microzyme from first portion of fluid filtered, but when saturated the microzyme passes freely through the filter.

Microzyme affecting *M. lyticus* was found to be present in varying amounts in practically all tissues of the human body. Especially strong were epidermal structures, respiratory mucous membrane and fibrous, fatty and cartilaginous connective tissues. Among body fluids, tears, sputum and nasal mucus are very rich in microzyme, saliva and blood fluids less so, while normal urine, sweat and cerebro-spinal fluid apparently contained no microzyme for *M. lyticus*. Tissues of dog, rabbit and guinea-pig all contain microzyme for *M. lyticus*, but usually in less amount than corresponding human tissues. Egg-white was found to be particularly potent, showing lytic action even when diluted 1 in 50 millions.

A small amount of microzyme for *M. lyticus* was found in the turnip. In human secretions microzyme was found exercising lytic action on most bacteria of the laboratory air, on bacteria pathogenic for animals but not pathogenic for man, and on many cocci isolated from the human body.

It is suggested that microzyme plays a large part in natural immunity and in immunity of particular tissues to particular infections.

J. W. PICKERING, D.Sc., and J. A. HEWITT, Ph.D. The Action of "Peptone" on Blood and Immunity thereto. Communicated by Prof. W. D. Halliburton, F.R.S.

The retardation of the coagulation of the blood resulting from the rapid intravascular injection of "peptone" into cats respiring air, or into cats with the liver out of the circulation, can be annulled by an increase of carbon dioxide in the blood. The anti-coagulant action of "peptone" is restored when the animals respire an excess of air or oxygen.

In cats respiring air, typical "peptone" retardation of coagulation can be produced by its rapid injection into animals with the liver out of the circulation. An explanation is given of the negative results of certain French experiments. Typical inhibition of the coagulation of the blood can be obtained by the addition of "peptone" to blood *in vitro*, with quantities of "peptone" no greater than those required to produce inhibition *in vivo*, provided the disturbance of the surface conditions of the blood, incidental to shedding, is sufficiently reduced. Leucocytes play no part in the anti-coagulant action of "peptone" on blood.

It is superfluous to assume that the anti-coagulant action of "peptone" on blood is due to the secretion of either antithrombin by the liver or by the endothelial cells of the vascular system, or is due to the secretion of excess of alkali by the liver. The slow injection of maximal amounts of "peptone" into cats, with the liver out of circulation, produces typical immunity to anti-coagulant action.

The hypotheses which assign "peptone" immunity to hepatic secretion are dismissed and a physical explanation is suggested. Perfusion experiments on the liver do not demonstrate that anti-thrombin is secreted by that organ. In the interpretation of the coagulation of the blood it is unnecessary to assume, as in current views, the existence of the following hypothetical substances, anti-thrombin, proantithrombin and anti-prothrombin, and the current "thrombin theories" become untenable.

THE GEOLOGICAL SOCIETY OF LONDON.

MARCH 8TH, 1922.—*Mr. R. D. Oldham, F.R.S., Vice-President, in the Chair.*—Dr. A. Smith Woodward described certain photographs (natural size) of *Desmostylus* teeth from the Lower Miocene Sandstone of

Southern Vancouver Island (B.C.) exhibited by Ira E. Cornwall, F.G.S.

The following communication was read: "On the Geological Importance of the Primitive Reptilian Fauna in the Upper Cretaceous of Hungary." By Baron Francis Nopcsa, For. Corresp. G.S.

The next meeting of the Society will be held on Wednesday, March 22nd, 1922, at 5.30 p.m., when a lecture will be delivered on "Leonardo da Vinci as a Geologist," by Sir Charles J. Holmes, F.S.A., Director of the National Gallery.

SOCIETY OF GLASS TECHNOLOGY.

A meeting of the Society of Glass Technology was held in Stourbridge on March 15th.

During the forenoon, members had an opportunity, through the courtesy of the respective directors, of visiting the works of Messrs. King Bros. (Stourbridge), Ltd., and of Messrs. E. J. & J. Pearson, Ltd., both firms being engaged in the manufacture of refractory materials.

The following papers were read and discussed:—

"Some notes on the production of Colourless Glass in Tank Furnaces," by A. Cowen, B.Sc., A.R.C.S., and Prof. W. E. S. Turner, D.Sc.

"Review of the Preliminary Specification for Refractory Materials used in the Glass Industry," by W. J. Rees, B.Sc. Tech., F.I.C.

The General Meeting of the Society will be held at Sheffield on April 6th.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society, held at the Imperial College of Science and Technology, on Thursday, 9th March, Sir Frank Dyson, President, in the chair, the following papers were presented and discussed:—

1. "A criticism of the nodal slide as an aid in testing photographic lenses," by T. Smith, M.A., F.Inst.P., and J. S. Anderson, M.A., D.Sc., Ph.D., F.Inst. P.

The nodal slide is only convenient for the examination of lenses over their entire field when these are of normal type.

Collimators and lenses should in general be directed to pass through all useful light as symmetrically about their axes as possible. Failure to secure this condition may lead to an underestimate of the excellence of the gravity of the faults present in bad lenses.

The nodal slide may with advantage be supplemented by suitable linkages, which enable all the special conveniences of the nodal slide to be retained. Some of the possible modifications are discussed.

2. "A non-polarising spectrophotometer," by A. J. Bull, M.Sc., F.Inst.P.

The paper deals with a form of spectrophotometer in which uniform monochromatic patches of colour are compared, instead of the more usual arrangement of two portions of a spectrum. A spectrum is arranged so that the upper half has undergone selective absorption by the material under test, and a narrow region of the spectrum is selected by a slit. A split lens then forms two images of the dispersing prism face. These images are brought into juxtaposition by means of a rhomb-like prism with slightly unequal angles, which corrects the divergence of the two beams produced by the split lens. Photometric balance is required by the partial closure of the lower portion of the selecting slit.

3. "The photometry of optical instruments," by J. Guild, A.R.C.Sc., F.R.A.S., F.Inst.P.

The use of a portable surface-brightness photometer of the polarisation type for the measurement of the fraction of the incident light transmitted by an optical instrument or reflected by a mirror or system of mirrors, and for the measurement of the relative brightness of different parts of the field of view of an optical instrument, is described. The instrument employed is a Wanner optical pyrometer (Cambridge and Paul Inst. Co.) with some modifications to render it suitable for such work. An addition to the instrument is described which removes the danger of error due to polarisation of the incident light.

4. "A projective treatment of the submarine periscope," by T. Smith, M.A., F.Inst.P.

The optical events which occur in an instrument such as a periscope may be illustrated by homocentric projection, and it is shown that this affords a simple means of finding the relative advantages or disadvantages of various arrangements of the optical system.

5. "Some measurements of the stresses produced at the surfaces of glass by grinding with loose abrasives," by A. J. Dalladay, A.Inst.P.

The method of measuring the stresses at

described, and measurements are given showing the relation between the size of grains of the abrasive used and the stresses produced.

THE SOCIETY OF DYERS AND COLOURISTS.

Manchester Section.

A meeting of the Manchester Section of Dyers and Colourists was held on Friday, March 17th. Prof. E. Knecht presided.

Two papers were read and discussed, the first being entitled, "Some Observations on the Behaviour of Oxidised Cellulose," by Prof. E. Knecht, Ph.D., M.Sc.Tech., F.I.C., and F. P. Thompson, M.Sc.Tech., an the second, "A New Protective Agent for Animal Fibres," by Alfred Edge. There was a very large attendance of members.

"Some Observations on the Behaviour of Oxidised Cellulose."

Prof. Knecht, who read the above titled paper, said that it related to the effect of o idation on the copper reducing property and ester reaction of cellulose. A method of determining the extent to which cellulose had been modified by oxidation or hydrolysis was described by Schwalbe in 1907. The cellulose product was boiled under standard conditions with alkaline solution of copper sulphate, and the amount of copper reduced had been termed the the copper number of the product. Pure cellulose was without reducing action but, oxidised with hydrolysed cellulose, together with certain esters, produced certain quantities of copper. In the more recent accounts of investigation of cellulose the copper numbers of the products were recorded. The actual numbers were of little importance, the chief significance being the higher the copper number the further was the product removed from pure cellulose.

The copper numbers of oxidised cellulose prepared by the various oxidising agents or processes varied considerably. This was no doubt due to the different conditions and variations in the extent to which oxidation had taken place. By the use of potassium permanganate in dilute acid solution, for the oxidation of cellulose, as described by the Secretary and himself in 1920, products could be obtained, the degrees of oxidation of which were known by the amount of oxidising agent employed. This process had now been used to prepare a series of products not varying the known degree of oxidation, and the copper values were ascercertained in each case for the purpose of discovering whether any simple relation existed between them and the amount of oxidant used in their preparation. Well bleached cotton yarn was used as the most convenient form of cellulose throughout the investigation, and the oxidation products were prepared by the use of permanganate to apply from one-sixteenth to 1, atomic proportion of oxygen per cellulose molecule counted on the $C_6H_{10}O_5$ unit. Weighed amounts of yarn were suspended in cold sulphuric acid of 10° twaddel, and to this was added the calculated amount of permanganate as concentrated solution, also in 10° twaddel Sulphuric Acid, so that no dilution ensued. The yarn was turned periodically in order to obtain an even result. The series was allowed to stand until oxidation was complete in every case, which required about 10 hours. A blank experiment was carried out without the addition of oxidisin agent. There was always a small deposit of manganese dioxide on the fibre during permanganate oxidations. In the previous investigation this deposit had been estimated to amount to not more than five per cent. of the total amount of permanganate employed, so that it was almost a negligible quantity. The products were finally decolourised with hydrogen peroxide and well washed and dried at a temperature not exceeding 30° C.

A number of tables were exhibited showing the results of the experiments in detail and giving exact data as to proportions.

In concluding the reading of the paper, Prof. Knecht said that in the initial stages of oxidation of cellulose by permanganate in cold acid solution, the rise in copper number was nearly proportional to the amount of oxidant used up. After the use of half the atomic proportion the rise in copper number was very gradual. The acetylation of oxidised cellulose was not found to give any indication of the effect of oxidation on the hydroxyl groups of cellulose, which was due to the very great reduction in the yield. Highly oxidised cellulose gave a high yield of water soluble products on acetylation. When nitrated under identical conditions oxidised cellulose gave products containing considerably less nitrogen than cellulose. It was inferred that oxidation resulted in the suppression of the

hydroxyl activity. Under the conditions which cellulose gave, labile mono-nitrate oxidised cellulose produced considerable quantities of nitric acid.

AN INTERESTING ISOLATION.

Before proceeding to the discussion of the paper, Prof. Knecht announced that, in collaboration with Mr. C. A. Hatton, B.Sc.,Tech., he had recently succeeded in isolating the nitrogenous cell content of the bleached cotton fibre. That something of the kind was present they had already known from experiments which were carried out by Dr. Schindler, in his (Prof. Knecht's) laboratory about 12 years ago. From the results of the nitrogen estimations it was concluded that the amount of albuminoid contained in the cotton fibre would be about 1.3 per cent. They had now isolated the albuminoid and it amounted to 1.2 per cent. It was an interesting substance, and further research work was being undertaken, the results of which it was hoped to report at a subsequent meeting.

Mr. J. Hannay, in proposing a vote of thanks to the authors for their paper, said that the chief difficulty of those who were interested in cellulose and its varied uses was to keep abreast with the steady advance of the research work which was being made. He hoped that before long some work would be published in which would be published all the information which had been so laboriously gleaned. It was very interesting to be reminded that Prof. Knecht had called attention to the Ketonic action of cellulose, years previously, in view of the fact that a short note had been read at a recent meeting of the Manchester Section of the Society of Chemical Industry by Mr. Huebner, who had ascertained that ketones were discoverable in water over which a portion of bleached cotton had merely been suspended for a certain number of hours. What the actual bearing of this discovery might prove to be upon works practice it was too soon to say. Such research work, however, was bound to enlighten them all as to the manner in which OH groups were attached to the carbon-cellulose atom, and was bound ultimately to have the greatest importance in regard to the practical application of cotton to cellulose in different forms of industry.

Mr. William Thomson, in seconding the vote of thanks, observed that the peculiarity that oxidised fibre gave a different amount of nitration from that obtained from was exceedingly interesting. The sample contained in the small bottle exhibited contained what was practically albumen. Perhaps it was possible to extract from cotton a product which was equivalent to egg? The product shown did not appear very appetising, but possibly if it was bleached it might be compounded into an exceedingly interesting food.

Mr. William Marshall, in supporting the vote of thanks, said that everyone seemed to fight shy of the constitutional formula of cellulose. Some years ago he had done some work on the acetylation of cellulose with the idea of keeping the fibre intact and not producing a solution. He found that mercerised cotton, for some considerable time, would not acetylate at all. There seemed to be a prevalent idea that the constitution was not very much altered from the chemical point of view. He, however, believed it was. The acetylation would start all right with the ordinary pure bleached-cellulose. He had about 20 experiments going on at once, the periods extending from one hour to 20, and eventually the mercerised cellulose would overtake the other, so far as the acetylation was concerned, but it also became so tender it could be powdered. It was a matter for inquiry as to whether mercerisation altered the molecule. He followed up the matter time after time, and always obtained the same result. The field of investigation thus opened up was a very wide one.

Prof. Knecht, in replying to the vote of thanks, said he was pleased to find it was considered that Mr. Thompson and himself had been able to make a little step forward in the study of oxidised cellulose. Apparently they would have to get the structure of cellulose built up by very little stages. He was very interested in Mr. Marshall's statement respecting the tendering of mercerised cotton, though he was unable to offer any explanation for the phenomenon. He was also not going to attempt to give a constitutional formula of cellulose.

"A NEW PROTECTIVE AGENT FOR ANIMAL FIBRES."

Mr. Alfred Edge, in reading his paper, said that the action of alkali upon wool, unless special care was paid to the strength of the alkaline liquors and the temperature at which the material was treated, was known to be very deleterious. If the treatment was too severe, the fibre might be completely destroyed. Between

its natural strength and lustre unimpaired, and the point of actual destruction there was a wide range of effect in which the durable qualities of the wool were more or less impaired, and its wearing qualities deteriorated. Having regard to the fact that a cleansing process with alkaline liquors was an essential feature in the production of textiles from wool fibre, it was somewhat surprising that the information available was so little applied in actual practice. Another point to be considered was the serious effect of the liquors upon the skin of the workman. At some mills both fine and coarse quality wools were given exactly the same scouring treatment, at others soap was used in hard water, and very seldom had the scourer any idea of the condition of the scouring bath. That important injury to the fibre was often caused in scouring was beyond question, and yet it was difficult to convince those responsible for the scouring operation that the process was worthy of careful and scientific investigation. So long as the wool was clean the object of the process was considered to be achieved. As to the effect of a too severe treatment during washing on the affinity of the fibre for dyes, no definite information was, to his knowledge, available, but it was at least possible that some of the dyers' troubles were due to a too drastic scouring while they knew that others were caused by an ineffective cleansing of the material. The Actien Gesellschaft fur Anilin-Fabrikation (Berlin) were now placing upon the market a product which they termed "Protectol." It was at present sold in the form of syrups which were readily soluble in water. The composition of the product could not be disclosed at present. The quantity to be used varied according to the quantity of alkali present. As a rule, half as much "Protectol" as soda ash was sufficient to afford protection from injury to the wool.

Mr. Edge then exhibited samples of wool which had been treated with "Protectol," and described its application to dark coloured rags, union dyeing, woollen piece goods, etc.

The one-bath method of union dyeing had been largely used during the past 25 years for all classes of materials, but particularly for the lower qualities. The method had disadvantages well known to dyers, and which were due to the operation being carried out in a neutral or slightly alkaline bath. This made it unsuitable for the more expensive and delicate union fabrics such as "pile" goods. The use of "Protectol" overcame these difficulties, and were a safeguard to the action of alkali.

"Protectol" also prevented the precipitation of the dye stuff by acids.

It was also now possible to rapidly and safely de-gum silk in an alkaline bath without damage to the fibre and with a great saving of steam and labour. The method had been successfully adopted by some of the most important silk firms in the country.

The dyeing of cotton with sulphide colours in mixed fabrics consisting of cotton and wool was also rendered possible.

A peculiar effect was noticed in the treatment of cotton and silk fabrics. A preliminary treatment with caustic soda was given in some cases, in order to increase the affinity of the cotton for dyes. This was usually carried out at a low temperature with caustic soda of 43° twaddel. When "Protectol" was used there was no shrinkage of the cotton during partial mercerisation, but the increase of affinity for the dyes, which was the reason for the process, was obtained just the same, and the silk was degummed without injury to the fibre.

In the dyeing of half silk with sulphide dyes various effects could be obtained with a proper regulation of the temperature.

Very unsatisfactory results had been obtained in the treatment of furs which were put through a process known as "killing." The object was to make the tips of the hair more receptive for the dye, and also to remove grease and tannin. The operation had a very detrimental effect on the fur itself, making it brittle at the tips, particularly so in the case of the more valuable furs. "Protectol" had given excellent results when used in conjunction with the "killing" liquors.

Its use had also been found quite satisfactory in the leather industry when aplied to what was termed the "liming" process for loosening hair.

A large firm of dyers and cleaners in this country were also using it as a protective agent in the dyeing of feathers.

The product has only recently been introduced into this country, and already very great interest has been taken in it. It was immediately taken up by several important silk firms. It is the intention of the manufacturers to place the substance

upon the market in a solid form, which by reducing the cost of carriage will make its use possible for even the cheapest classes of goods.

A large number of enquiries respecting further possible uses of the substance in connection with the dyeing and textile trades were then addressed to, and answered by Mr. Edge.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next meeting of the Society will be held on Wednesday, April 5th, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following papers will be read:—

"The Constants of Indian Beeswax," by O. D. Roberts, F.I.C., and H. T. Islip, A.I.C.

"Note on the Liver Oil of the 'Tope' (Galeus galeus)," by A. Chaston Chapman, F.R.S., F.I.C.

"Note on the Examination of Foods for the presence of Sulphites," by A. Chaston Chapman, F.R.S., F.I.C.

"Demonstration of Artificial Daylight for Laboratory Purposes. (Sheringham System)," by Sydney H. Groom, B.A.

"A Tropical Milk Supply," by Alexander Bruce," B.Sc.

"Certain Tropical Oilseeds," by E. R. Bolton, F.I.C., and D. G. Hewer, B.Sc.

STUDENTSHIPS.

CITY OF LONDON COLLEGE, WHITE STREET, MOORFIELDS, E.C.—DAY SCHOOL OF COMMERCE.

A limited number of free places will be awarded on the results of an examination to students resident in the administrative County of London who, in the opinion of the Governing Body, cannot be expected to pay the ordinary fee.

The Studentships will be tenable for the Academic Year commencing Tuesday, 19th September, 1922. Candidates must be sixteen years of age or over on that date. The Studentships may be renewed by the Governing Body for a second year upon a satisfactory report of the student's progress from the Headmaster. Those who obtain Studentships may take a course in preparation for the Intermediate Commerce Examination of the University of London or, if girls, the Secretarial Course.

The examination will be held at the City of London College on Thursday, 1st June, 1922, from 10 to 1, and 2 to 4.

The subjects of examination will be:—

(a) English Essay.

(b) Mathematics including Arithmetic, Algebra, and Geometry.

(c) French.

The scope of the examination in these subjects will be roughly that of the Matriculation of the University of London.

Form of Entry and further particulars can be obtained from the Secretary.

G. R.

BY DIRECTION OF THE DISPOSAL BOARD.

CHEMICAL NOTICES FROM FOREIGN SOURCES

SOLUBILITY OF ISOMERIC ACIDS IN THE THREE XYLENES—*M. Chapas*.—Para-toluic acid is only very slightly soluble in the three xylenes. The author has already shown that p-nitraniline is also very much less soluble in m-xylene than its isomers. These facts recall the lower volatility of the para derivatives of benzene. Meta-toluic acid has the highest coefficients of solubility, but they are not very different from those of the o-toluic acid. If the solubilities of the same acid in the three solvents are compared, it is seen that p-xylene has the greatest solvent power, while that of m-xylene is the least, but isomerism does not seem to have a great effect upon the solvent power of a compound.—(*Comptes Rendus*, CLXXIV., 1922, No. 9.)

CATALYTIC PREPARATION OF CYCLOHEXANE TRIOLS—*J. B. Senderens and J. Aboulenc.* —When pyrogallol is reduced in an aqueous or alcoholic solution and under a pressure of 40-50 Kg in presence of nickel, two isomeric pyrogallites are formed. The reduction is complete at a temperature of 140°, and the product does not give the reactions of pyrogallol. The two isomers can easily be separated owing to the difference in their solubilities in both water and alcohol. Pyrogallite melts at 145°, and distils without undergoing decomposition at 290°. It is less soluble in alcohol than in water. The α_2 compound is more soluble in alcohol than in water, and melts at 95°. Both compounds combine with three molecules of acetic acid to give a triacetate. Phloroglucine can easily be reduced in aqueous solution under pressure, the re-

action occuring according to the equation $C_6H_3(OH)_3 + 3H_2 = C_6H_9(OH)_3$. The mixture of phloroglucites thus obtained is gelatinous and distils at 245-260°. It combines with three molecules of acetic acid. Exactly the same reduction can be brought about with oxyhydroquinone, a mixture of isomeric oxyhydroquinites being obtained. —(*Comptes Rendus*, CLXXIV., 1922, No. 9.)

SOME DERIVATIVES OF SUBERONE—*Marcel Godchot and Pierre Brun.*—When calcium hydride acts on suberone a very good yield of cycloheptylidene-cyclo-heptanone $C_7H_{12} = C_7H_{10}O$ is obtained. This new bicyclic unsaturated ketone is a liquid which boils at about 143-145° under 8mm. pressure. When hydrogenated by means of absolute alcohol and sodium, it gives a secondary alcohol $C_{17}H_{13}-C_7H_{12}OH$. The authors have incidentally studied the action of bromine upon suberone. When a little bromine dissolved in an excess of carbon tetrachloride is added to a similar solution of suberone dibromo-suberone $C_7H_{10}OBr_2$ is obtained. It is noteworthy that when bromine acts on cyclohexanone or cyclopentanone a tetra bromo derivative is obtained. Unlike these tetrabromo compounds, dibromo suberone is very stable, and can be kept for months without undergoing any alteration, even when exposed to light. When treated with dilute soda in the cold, it yields a syrupy substance, very soluble in various solvents, uncrystallisable and decomposing on distillation, even in a vacuum. It very readily reduces Fehling's solution, and is in all probability a cycloheptane diol-one. — (*Comptes Rendus* CLXXIV., 1922, No. 9.)

DEWINDTITE, A NEW RADIOACTIVE MINERAL.—*Alfred Schoep.*—This mineral comes from Kasolo (Katanga, Belgian Congo). It is found mixed with chalcolite. It is canary yellow in colour, pulverulent or rarely compact, and impregnates certain pieces of chalcolite so as to fill in all the spaces which occur between the crystals of this mineral. It can be extracted without much difficulty by washing with distilled water, but it is not so easy to separate the yellow mineral from a sort of white gangue, which occurs mixed with the chalcolite and which resembles an impure talc. The yellow mineral crystallizes in spangles, the radioactivity of which is higher than that of kasolite. The average composition of the mineral is as follows: —

P_2O_5	10.01	
UO_3	55.50	
PbO	21.74	
Fe_2O_3 Al_2O_3	2.06	(Very little Fe_2O_3)
CaO	1.32	
MgO	2.75	
H_2O	5.82	
Insoluble matter	0.40	
	99.60	

The white gangue, when treated with hydrochloric acid and heated, partly dissolves, the insoluble residue amounting to 30.24 per cent. The solution contains 33 per cent. of Al_2O_3, 11 per cent. of MgO, and 5 per cent. of CoO. The author suggests the name dewindtite for the new mineral, in honour of Dr. Jean Dewindt, the Belgian geologist.

NOTES ON BOOKS.

Organic Syntheses (*Vol. I*).—An annual publication of satisfactory methods for the preparation of organic chemicals. Editor-in-chief, ROGER ADAMS. New York: John Wiley and Sons. London: Chapman and Hall, Ltd. 1921, pp. viii. plus 84. Price 8/6 net.

Since 1914, American chemists have been unable to obtain adequate supplies of many organic reagents. The necessity arose for investigators to prepare comparatively simple bodies, such as alkyl haloids, for their own use.

The present volume (the authors term it a pamphlet) is the first of a series in which the joint authors intend to make the results of their investigations permanently available, giving reliable methods for preparing such chemicals in quantities ranging from 200 grms. to 2.5 kilos. Complete directions are given for the preparation of 23 substances. The most suitable method and apparatus are specified, and the temperature limits and time required for each stage are recorded. The yields quoted are generally higher than those usually obtained for such preparations, although there is little new in the methods employed.

Only results that have been duplicated in two laboratories are included. As a result of this commendable procedure, widely different substances, such as trimethylene bromide, benzoin, furfural, thiophenol, etc., are among the twenty-three compounds whose preparation are described. The processes are generally very satisfactory ones, but the method given for the preparation of a 48 per cent. solution of hydrobromic acid is the interaction of bromine and sulphur dioxide in the presence of water. The authors are apparently unacquainted with Pickle's method (*Chemical News*, 1919, 119, 89) in which sulphuric acid acts upon potassium bromide in the presence of a little stannous chloride.

Notes on other modes of preparation for each substance are appended, and the reasons are given which led to the selection of the method finally chosen.

Aggregation and Flow of Solids, by Sir George Beilby, F.R.S. London: Macmillan & Co., Ltd., 1921; pp. xvi. plus 256 plus 34 plates. Price 20/-.

In this volume the author has compiled the results of his studies, extending over 20 years, on the Micro-structure and physical properties of solids in various states of aggregation. A theory of polishing of metal and other surfaces is advanced, in which it i considered that the phenomena associated with polished surfaces are due to the presence of a surface tension skin as in the case of liquids. This is the conclusion reached as the result of exhaustive studies of polished surfaces, especially in the case of speculum metal, and a repetition and extension of Faraday's experiments on the thinning of gold leaf by treatment with potassium cyanide solutions.

Micro-photographs—some of high magnification taken in natural colours with autochrome plates—clearly demonstrate the spreading of a definite layer over the surface by polishing, and its removal by solvents.

It is further indicated, that polish is the result of surface flow, which itself is due to the solid passing, partly or completely, into the vitreous state. This accounts for the fact that such operations as filing, grinding, etc., produce a thin surface film which differs essentially from the rest of the solid. This surface film is formed by a certain mobility conferred upon the thin layer of molecules by the instrument uesd. While in this mobile condition the film behaves like a liquid.

The author attributes the hardening and re-softening of metals in annealing and other processes to the fact that the change from the liquid to the solid states may produce either a crystalline or a vitreous aggregate. Sudden solidification of the mobile layers of ductile metals produced by the flow of the metals can also convert a part of the metal into the vitreous state. This affords a satisfactory explanation for the breaking of metals under strain, that is, of "fatigue."

THE APPLICATION OF THE PRINCIPLES OF EFFICIENCY TO THE TEACHING OF CHEMISTRY.

By J. Norman Taylor.
George Washington University.

By Favour of the Author.

(*Continued from last week.*)

Schedules.

Having now made plans, schedules must be employed to assist in the execution of them, and again we go back to a study of the standards which we have established. These, of course, were obtained from a study of records made over a period of time.

Schedules save time and energy, add interest to work, and are a great aid to concentration. Schedules, properly worked out, assure us of an adequate time supply for each task. The late Professor William James, in his "Talks to Teachers," says:

"Your intense, convulsive worker breaks down and has bad moods so often that you never know where he may be when you most need his help. He may be having one of his 'bad days.' We say that so many of our fellow-countrymen collapse, and have to be sent abroad to rest their nerves because they work so hard. I suspect that this is an immense mistake. I suspect that neither the nature nor the amount of our work is accountable for the frequency and severity of our break-downs, but that their cause lies rather in those absurd feelings of hurry and having no time, in that breathlessness and tension, that anxiety of feature and that solicitude of results, that lack of inner harmony and ease, in short,

by which with us the work is apt to be accompanied, and from which a European who should do the same work would nine times out of ten be free. . . . It is your relaxed and easy worker, who is in no hurry, and quite thoughtless most of the while of consequences, who is your efficient worker; and tension and anxiety, and present and future, all mixed up together in one mind at once, are the surest drags upon steady progress and hindrances to our success."

In arranging a schedule for carrying out an experiment in the laboratory, or for a lecture illustrated by demonstrations, there will be listed the equipment necessary, both as to quantity and place and the standard time for the operation.

Despatching.

It is not enough to establish standards, to plan, to write schedules. The things in question must be done, and done at the proper time. In other words, the schedule must be despatched. A good rule for the laboratory and lecture room for both instructor and pupil is, "always begin on time and finish on time." If the schedule is maintained and each operation is despatched promptly, much waste of time will be prevented. Ordering of supplies should be despatched in sufficient time for the goods to arrive before the beginning of the fall term. Despatching of the instructor's reading and studying will prevent the accumulation of too many books and periodicals and will greatly assist the instructor to keep up with the latest and best thoughts of his profession. Aids in dispatching such as bells, gongs, or buzzers, index cards arranged for months and days (sometimes known as "ticklers"), interval clocks, stop watches are valuable and should be freely used. All of these mechanical devices are, however, dependent upon mental training, as efficiency in despatching is essentially a mental quality.

Standardised Conditions.

When the conditions under which the instructor and pupils work have been standardised, the work will be carried on much more quickly and in an *easier manner.* Much less conscious mental effort is *required where standardised conditions* obtain. These include lighting, ventilation, maintaining a proper *temperature, equipment,* and library facilities. It may be of interest to some readers of this paper to note a description by the present writer of at the Washington Y.M.C.A., which appeared in the *Journal of Industrial and Engineering Chemistry* for June, 1920.

Alphabetical or numerical seating of pupils saves time in taking attendance and helps in noting absences. Arrangement of chemicals alphabetically is an excellent procedure. A higher efficiency of assignment will be attained by the instructor, and his time therefore be used to better advantage, if minor details are assigned to some of the pupils. A pupil invariably feels complimented when appointed for the period as a laboratory assistant, and takes a lively interest in getting out and putting away materials, and in seeing that the other students keep things clean.

Standardised Operations.

It is impracticable to go very far in standardising conditions without first standardising the operations by which the conditions were brought about, and oftentimes we must first break away from tradition before we can properly get on a new and better basis. Standardised operations replace guesswork by accurate knowledge. They are orderly.

As an example to chemistry teaching may be given the arrangement of apparatus in conducting experiments—the proper assembling and setting up of the parts so that they are in "co-ordination." In demonstrating, it is well to arrange apparatus and chemicals in the order in which they are to be used and from left to right.

It will be found if students are instructed to note their laboratory experiments in a uniform manner—as for example (1) Object, (2) Apparatus and Materials, (3) Procedure, (4) Observations, (5) Conclusions or Results—that it will be much easier for the instructor to eamine the note books. However, as the note book is the pupil's own record of what he does, the instructor's standards regarding acceptable forms of notation should be flexible. Diagrams accompanying procedure are desirable. Answers to specific questions should be included in the note book.

Professor Munroe's "Scheme for Chemical Recitations" is one deserving of special mention, and the "Freas System" for distributing chemicals in the laboratory is helpful and easily installed. An economy in energy expended in the stockroom and in the accounting department is the ordering

WRITTEN STANDARD PRACTICE INSTRUCTIONS.

The universal application of the seventh principle is familiar to everyone: school books, technical books, professional and trade journals, mottoes, slogans, recipes, legal forms, style rules and many more are in everyday use.

In connection with the teaching of chemistry—records, plans, schedules, and memoranda for dispatching have created a body of written standard practice instructions.

Perhaps the most notable example is the laboratory manual. The loose leaf system presents a number of favourable features. Included as a part of the loose leaf laboratory manual are sheets setting forth the general rules governing the laboratory; tables, such as the metric tables, the elements with their symbols and atomic weights, solubilities, water vapour pressure; first aid; and textbook references. The type of student in continuation schools, particularly those students attending the Washington Y.M.C.A. presents, on the average, those persons of more mature minds. Accordingly, the direction sheets have been prepared with the particular idea of setting forth, in an elementary way the subject of chemistry in great measure by the laboratory method, and for a class of students more mature than the average high school pupil.

The textbook, another example of written standard practice instructions, is next in value to the laboratory manual. Its proper function is to elucidate the experimental facts and to furnish information that is not accessible to the student by experiment. Of course, the laboratory work should be accompanied by recitations, discussions, and lectures with demonstrations. The experimental facts and common knowledge should be presented, not as isolated things, but to correlate and explain modern theory.

Special instruction sheets may be issued from time to time as occasion demands, and may constitute a part of the laboratory manual. Professor Mnnroe's method of balancing equations should be in the hands of every chemistry student. Proficiency in working out stoichiometrical problems may be developed by the solution of practical problems submitted to the student at regular intervals. Energy and time may be conserbed by enlisting the co-operation of the school office in the matter of multigraphing the sheets.

Some other examples of written standard practice instructions familiar to chemistry teachers are specifications for making, ordering and purchasing materials and equipment, graphs, charts of organisation, slide rules, formulas for quick calculating, standard methods of analysis, and the various chemists' manuals and annuals.

Concluding the consideration of the seven practical principles, we come to a survey of some of those which Mr. Emerson includes in the moral or ethical ones. In his classification he differentiates those which are mechanical in their applications from those which are basic or mental.

IDEALS.

We are all aware of the value and dynamic worth of high ideals.

We are conscious of the futility of confused ideals. To quote Harrington Emerson, "the vessel that sails for no particular port reaches any port at all only by the rarest accident."

We recognise the waste of wrong or mistaken ideals. Material efficiency must be guided by something more than materialistic ideals. This truth was effectively set forth in the convocation address [5] by Dr. Charles Alexander Richmond, President of Union College, at the centennial celebration of George Washington University. In speaking of the unwise use of science, he said:

"We have had now something like fifty years of an education which has become more and more absorbed in studying and applying the powers and processes of physical nature. So far as it has applied to man it has been as an interesting and highly diversified animal, rather than as a spiritual being. When we count up our gains and losses we are often perplexed to know on which side the balance lies. Certain large promissory notes have not been made good. Many of our profits are paper profits, and not a few of our securities have gone bad. She has promised us civilisation, she has given us physical comfort; she has promised us emancipation, she has given us efficiency; she has promised us content, she has given us more discontent, by multiplying cravings which she does not and cannot satisfy. As for the promise of happiness,

5 Proceedings of the Centennial Celebration of George Washington University, February Nineteenth to Twenty-sixth, 1921, University Bulletin, Vol. XX., No. 1, March, 1921.

that note has certainly gone to protest. The fault is not with science, the fault is our own. We have been asking her to give us that which was not hers to give. * * * * *It is a subject of Homeric mirth to* see the use we make of our time, our energies, our genius, our resources. * * * * Never in the history of mankind has he been so utterly the slave of things. * * * * The underlying theory of it all, held, as I believe, quite unconsciously, is that the possession of money will emancipate from the bondage of work and enable us to live free and easy lives; and that this is the goal of human aspiration and the only happiness we can be sure of. * * * * To make *such a theory the foundation of a system of* education and to teach our children in the schools and the young men and women in *our colleges that this is life, would be like* injecting an insidious kind of poison into them, which would slowly corrupt the blood and in the end destroy all the finer impulses and ideals. * * * * My plea to-day is for the safeguarding of these higher values; a regard for the ultimate rather than the immediate."

In the younger student, ideals are sometimes held subconsciously. How many of us in sitting at the feet of our teacher have embodied our ideals in him! And some of us may have had an ideal born by a chance word or look or action on the part of our preceptor.

Too much emphasis cannot be laid upon *the aims in the teaching of chemistry* in high school or college. The following admirably formulated ones are particularly *important:*

1. To give an understanding of the significance and importance of chemistry in our national life.
2. To develop those specific interests, habits, and abilities to which all science study should contribute.
3. The necessity of awakening the minds of our pupils to the possibilities of achievement.[7]
4. The understanding and use of the scientific method of procedure.[6]
5. Acquisition of knowledge which serves as a basis of skills.[6]
6. *To inculcate moral law and to emphasise universal order.*
7. To at least, "exercise the pupil in applying standard methods to new problems, with the possibilities that he may learn later to use the same methods in life, and so become a rational and useful citizen."

Attention is drected to the apparent necessity for high school chemistry, in order to be vocational, to include a three year course. College courses in chemistry should be co-ordinated with the preparatory school courses, so that students upon entering college can take up the study of chemistry without repetition of their previous work.

COMPETENT COUNSEL.

Contact with others who are doing the same kind of work, and exchange of ideas is indispensable in any line of work. This is particularly true where the teaching of a gr wing and advancing science is concerned.

Membership in the American Chemical Society, Chemistry Teachers' Associations, the American Association for the Advancement of Science and other organisations of similar character, attendance upon meetings, *conventions, and expositions;* and keeping up with the times by subscribing to and reading the current chemical literature are excellent examples of competent counsel.

The school library is an important example of competent counsel. Extensive lists of books suitable for a chemistry library have been issued by the New England Association of Chemistry Teachers and by the Chemistry Teachers' Club of New York City. The American Chemical Society has in preparation reading courses on Chemistry. Subscription to some good periodical on business methods will undoubtedly be advantageous to the chemistry teacher.

A systematically arranged collection of substances that are of interest to students of chemistry is of great help in teaching, as are also occasional trips to manufacturing establishments and to industrial museums and those illustrating natural history.

A departure in museums, of particular interest to the chemical profession, is the *Museum of Chemical Types established by* the Smithsonian Institution, to fulfil a bequest of the late Morris Loeb. The museum will include original specimens of all new chemical substances and make them avail-

6 Report of the Commission on the Reorganisation of econdary Education, Published in "Treasure Hunting of To-day and Chemistry in Our Schools." Bureau of Education,

7 Resolutions of the Chemistry Section of the Department of the Interior, Washington. Central Association of Science and Mathematics Teachers. Published in This Journal, March, 1921.

able to research workers for reference purposes.

Other examples of competent counsel are bulletins of the Government Departments, manufacturers' catalogues, Lefax, and chemical dictionaries and encyclopedias.

COMMON SENSE.

Almost indefinable, this quality is one of the greatest value to the teacher.

It is a guide in the choice of ideals, major, minor, and lateral.

It is a guide in the choice of standards.

It is the guide to good judgment—sound, instinctive reasoning.

It is the best guide to all our actions and decisions in the class-room and out.

It can be developed.

Its very essence is *mental alertness*.

The fair deal, discipline and the efficiency reward hardly need any comment. The essential elements underlying the principle of common sense apply to these also. In order to be of the greatest service the chemistry teacher must not only require a fair deal from others, but he must be fair to himself. Too much emphasis cannot be placed upon the value of health culture. Sufficient sleep, proper food with plenty of vitamines, and sufficient recreation are prime considerations.

By all means cultivate a sense of humour. It is a saving grace. "The teacher who can appreciate the humour of a *mistranslation*, of a *ludicrous* mistake, of a ready reply, of a disciplinary situation that is at once serious and comic, has a power that will destroy the bitterness of many a heartache and save the day in many a disciplinary crisis. If he is himself something of a humourist, so much the better.

Assiduity in the application of the principles indicated above—always keeping in mind the ideals which we have formulated and allowing common sense to guide us—will bring us our reward; better chemistry teaching; more leisure for self improvement; a greater enjoyment of work and play; and, in larger measure, the ability to both aspire and inspire.

A Dictionary of Chemical Terms by Couch (D. Van Nostrand & Co., New York) should be available to every chemistry teacher.

Brown, John Franklin, "The American High School," The Macmillan Co., New York, 1914.

New Patents.

THIS list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

7167—American Smelting & Refining Co.—Method of treating metallurgical gases. March 10

6843—British Cellulose & Chemical Manufacturing Co., Ltd.—Manufacture of compositions with cellulose derivatives. March 8.

7170—Blagdon, J. W.—Manufacture of thymol. March 10.

6891—Burt, Boulton & Haywood, Ltd.—Manufacture of colloidal sulphur. March 8.

6931—Clark, F. W.—Process of manufacture of gas from coal, etc. March 9.

6509—Coles, S. O. — Production of zinc foil. March 6.

Specifications Published this Week.

175680—Venditti, Dr. L.—Apparatus for effecting the crystallisation of sugar solutions.

175795—Harding, K.—Process for the production of sodium pentaborate from boren ores.

156103—Chemische Fabriken Flora.—Process for the manufacture of solver thioglycollate of sodium.

156543—Farbenfabriken Vorm. F. Bayer & Co.—Process for separating or isolating organic gases or vapours or organic products.

159843—Szarvasy, I.—Apparatus for treating gases with silent electric discharges.

Abstract Published this Week.

Formates of Alkali Metals.—Patent No. 174,125.—Messrs. Oldbury Electro Chemical Co., of Niagara Falls, New York, U.S.A., have obtained a patent in this country for a new method of manufacturing caustic alkali solution.

The solution is treated with carbon monoxide in the presence of a finely-divided inert solid initially suspended in the solution. Contact between the gas and the liquid is thus promoted. The solid may be calcium salt containing carbon and oxygen. Calcium carbonate, formed in the manufacture of the caustic alkali solution from sodium carbonate solution and lime, may be left in the solution during treatment with carbon monoxide. Calcium oxalate, precipitated by lime from alkali-formate solution, as described in Specification 160,747, may be similarly employed.

Mercuric Chloride.—Patent No. 172,205.—A new process for obtaining Mercuric Chloride has been invented by Mr. K. Schantz, of 8, Reischstrasse, Freiburg-im-Breisgau, Germany.

The product is produced by dropping mercury through an atmosphere of chlorine into a liquid which does not absorb chlorine. The liquid may be hot water or mercuric chlorine solution, and the temperature may be kept down to about boiling point by adding fresh cold liquid. The apparatus may consist of a rotary drum having blades which lift the mercury and drop it into the liquid, and the chlorine may be introduced under moderate pressure.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on, post free, for the official price of 1s. each.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3234.

A REVOLUTION IN MEDICAL SCIENCE.

A paper of world-wide interest as affecting the health problems of the age was read at a meeting of the Manchester Section of the Society of Chemical Industry on Thursday, the 30th ult. The meeting was held at the Manchester College of Technology.

The Paper read was on "The Relation between Chemical Constitution and Antiseptic action in the Coal Tar Dyestuffs," by Thomas H. Fairbrother, M.Sc. (Vict.), A.I.C., and Arnold Renshaw, M.D. (Lond.) D.P.H. (Manc. and Cantab.), and dealt with their joint research work on the subject.

The paper is a welcome indication of the success which attends collaboration on the part of the practical industrial scientist, such as Mr. Fairbrother, who is a member of the Technical Research Staff of the British Dyestuffs Corporation, and the investigator of pathological problems, such as Dr. Renshaw, who is a member of the Pathological Staff of the University of Manchester, Pathologist to Ancoats Hospital ,and also Bacteriologist for the Manchester Royal Eye Hospital. Both these gentlemen have been doing research work for nearly fonr years on the antiseptic action of certain dyes on bacteria and the lethal action of the same dyes on protozoa.

The following preliminary general report of the subject matter of the paper has been supplied by the courtesy of Mr. L. Guy Radcliffe, M.Sc.Tech, F.I.C., Hon. Sec. of the Manchester Section of the Society of Chemical Industry.

The work to be described by the authors of the paper has been conducted along lines in which the chemical constitutions of the dyestuffs were carefully considered, and certain dyes have been found which possess powerful antiseptic properties. These dyes are coal tar derivatives and typical members of the different groups of dyes have been examined. Certain dyes of the Azo class show so little antiseptic action that even moulds can grow in them in a concentrated solution. There are, however, other groups such as the triphenylmethane group, the safranines, the oxazines, and the acridines which exhibit antiseptic properties in varying degrees. Some of these are most powerful antiseptics, preventing the growth of organisms like Typhoid and Anthrax bacilli in dilutions of 1 in 5,000 and killing certain protozoa in dilutions of 1 in 20,000, while the latest results indicate that with certain mixtures of dyes the action in regard to protozoa can be extended to a dilution of 1 in 120,000 of these dyes.

In the paper, the whole field of medicine with the dyes employed, antiseptic action to which diseases, in which known agents are at work, still remain without a definite cure. The present work is along the lines of Ehrlich's Chemio-Therapeutic work which resulted in the preparation of salvarsan. In this work some of the test agents employed were found not to be affected by neo-antiseptic action, 1 in 200, whereas, with the dyes employed,antisep tic action was reviewed, and indications made as 2,000, and, after 15 minutes, in dilutions of 1 in 20,000.

Experiments would appear to indicate that some of these substances may possibly be given even intravenously into human beings, and further work on these lines is being undertaken. Experiments have been conducted on animals with some success. Indications will be given later as to the manner in which medical men now await further chemical advances.

In other words, accurate diagnosis now awaits specific treatment. Thus the known agents of typhoid, dysentery, and cholera can be recognised easily, to mention only a few, while with tropical diseases there is a vast field to explore in such cases as malaria, sleeping sickness, kala azar, and filariasis, with regard to which really, with the exception of malafia, very little has been done, and even in the case of malaria a better agent than quinine may be found.

Modern medicine will undoubtedly have to progress along the lines of applying a precise specific chemical substance to kill off a known infective agent. This is already done in some diseases ,such as diphtheria, where diphtheria antitoxin can he given, and such as syphilis in which salvarsan is used, but this merely represents the fringe of the field which is yet to be explored. When this work can be done, the amount of suffering in the world can be enormously reduced by killing the infective agent in the early stages before gross damage to tissues has resulted.

The British Dyestuffs Corporation, Ltd., Blackley, have shown great interest in the work undertaken by the authors of the Paper one of whom, as has been already stated, is a member of their Technical Research Staff. The firm are affording every facility in their power to the investigators with a view to making the results obtained of great practical value to the medical profession and to the general public.

POLYMERISATION AT THE CRITICAL TEMPERATURE.

By Wm. R. Fielding, M.A., M.Sc., Vict., Senior Science Master at King Edward VII. School, Lytham.

[NOTE.—The data used in this paper have been taken from Landolt-Börnstein's Tables, and the paper is a continuation of "Polymerisation amongst Liquids," *Chem. News*, 1921, Vol. 122, p. 289.]

There are not many data available for the study of specific heats under pressure: hence the difficulty of deriving a reliable formula connecting the degree of polymerisation and critical constants.

Let us first take the case of *ether*, in order to discover the influence of pressure alone on the degree of polymerisation, the temperature remaining constant. We have for ether:

Temp.	Press.	Sp. Ht. (observed).
303	1	0.547
448	50	1.128
448	300	0.976

At 448° the specific heat decreases from 1.128 to 0.976 as the pressure is increased from 50 to 300 atmos. Now the specific heats of polymerised water at 273° A. were calculated (*Chem. News*, 1921, Vol. 122, No. 3,193, p. 292) to be:—

$(H_2O)_3$	(ice)	0.5
$(H_2O)_2$		0.945
(H_2O)		1.890

so that ether, under the higher pressure, is likely to be more polymerised than under the lower. The vapicular weight corresponding to 448° A. is about 257 (*Chem. News*, 1921, Vol. 122, No. 3,193, p. 290), from which

R = 2.64
s (calc) = 2.576
∴ *p (50 atmos.)* = 2.29
p *(300 atmos.)* = 52.1

That is, p is increased by 0.35 for an increase in pressure of 250 atmos., or an average increase in p of only 0.0014 for atmosphere increase of pressure. Thus, at the critical point where

Tc = 467
Pc = 36

p for ether will be about 2.10.

Water. — Landolt-Börnstein gives two series of specific heats for water, at temperatures above 373° A. Regnault's values for temperatures above 373° are considerably less than Dieterici's, but unfortunately only go to 453° A., so I have calculated p at the higher temperatures from the latter values.

T	Vap. Wts.	s (Regnault).	s (Dieterici).	p
373	209	1.0122	1.0099	2.06
453	261	1.0355	1.0482	
473	277		1.0619	2.03
573	342		1.1543	1.90
647 (C.T.)			1.28 (graph)	1.5-1.742

Graphing p from Dieterici's specific heats, and bearing in mind the lower trend of Regnault's values which would make p higher still [s (calc) ÷ s (observed)], I concluded that p for water at the C.T. would be about 1.74.

Amylene.—The following data are available:—

T	P	s
448	50	1.019
448	300	0.889

Vap. Wt. = 257.
R = 55
s (calc) = 2.719
∴ p (50 atmos.) = 2.66
p (300 atmos.) = 3.06

Thus, one atmosphere pressure raises p by 0.0016 (cf. ether).

At the critical temperature,

Tc = 476
Pc = 40

∴ p will be about 2.50.

The values of p at the critical temperature so far obtained are:—

	C.T.	C.P.	d_c.	p.
Water	647	217.5	0.329	1.5-1.74
Ether	467	36	0.26	2.10
Amylene	476	40		2.50

These values, as one would expect, are intermediate between the values at the boiling-point (atmos. press.) and in the gaseous state.

The following equation not only gives the above values for p, but also what seem to be not unlikely values for other sub-

stances.

$$p = \frac{MP_c}{k\, d_c\, T_c}$$

where M is the formula weight.
p is the degree of polymerisation at T_c
d_c is the critical density.
P_c is the critical pressure.
T_c is the critical temperature.

$$\therefore\ k = \frac{M\ P_c}{p\ d_c\ T_c}$$

Substituting data for ether,

$d_c = .26$
$P_c = 36$
$T_c = 467$
$M = 74$
$p = 2.1$
$\therefore\ k = 10.5$

Thus, the general formula is

$$p = \frac{M\ P_c}{10.5 \cdot d_c\ T_c}$$

Guye (*Ann. Chim. Phys.*; 1892, (6), 26, 97) derived the equation:

$$\frac{M}{28.87} = \frac{1146\ d_c\ T_c}{P_c(\ T_c + 1070)}$$

but, my results do not agree well with his. In fact, his "molecular" weights (i.e., polymericular weights) often come out less than the formula weight (e.g., Xenon).

N.B.—To get my values for *elements*, I have substituted the *atomic* weight in my equation. E.g., each argon atom becomes $(A)_{2.36}$ at the critical temperature, and each hydrogen molecule, H_2, is still H_2 at its critical point. See Table I.

Chem. News: 3: Polymerisation at the Critical temperature, Continued

TABLE I.

Substance	d_c	T	P	Formula Weight	p
Br ...	1.18	575	129?	80	1.44
H ...	0.033	32	11	1	0.99
O ...	0.43	155	50.8	16	1.15
N ...	0.327	127	33	14	1.05
A ...	0.509	151	48	39.9	2.36
Kr ...	0.775	210	54.3	82.9	2.61
X ...	0.92	288	57.2	130.2	2.60
N_2O ..	0.454	312	77.5	44	2.28
CO_2 ...	0.46	304	73	44	2.17
SO_2 ..	0.52	430	78	64	2.11
H_2O	0.429	647	217.5	18	1.34
	0.329	647	217.5	18	1.43
$SnCl_4$	7419	592	37	261	2.09

Before calculating p for some of the organic compounds, it is interesting to compare the specific heats of a few substances in the liquid and gaseous states at, or near, the critical temperature. First, take the case of gaseous N_2O. At the C.T., as the pressure is increased, the gas is approximating to the liqpid state, until when the C.P. is reached the identity of the gas is merged in that of the liquid, *i.e.*, the fluid is homogeneous and p is likely to be greater than 1.

Liquid State.
$Tc = 312$
$Pc = 77.5$
$p_c = 2.28$
$s_c = 0.3528$

Gaseous state.
T = 300 - 473°. Avge Temp = 386°
s (at const. Press) (1 atmos) 0.225
(,, ,, ,,) (30 ,,) 0.278
(,, ,, ,,) (77.5 ,,) 0.344

The last value, s under a pressure of 77.5 atmos., in the gaseous state, is obtained by plotting specific heats against pressure and producing the graph as a straight line to the C.P.,

$$\text{i.e., making } \frac{P_3 - 1}{P_2 - 1} = \frac{s_3 - s_1}{s_2 - s_1}$$

where s_1 *is the specific heat of the gas at* constant (atmospheric) pressure. Note the ratio,

$$\frac{\text{Observed sp. heat of gaseous } N_2O \text{ at T.}}{\text{sp. heat of liquid } N_2O \text{ at C.T.}}$$

The temperature, T., should be the critical temperature, but I have had to accept some results at a slightly different temperature. See Table II.

TABLE II.

	T	P	s		spec. heat. / sp. ht. at C.T.	
Gas	386	1	0.225		0.636	1
	,,	30	0.278		0.788	1.24
	,,	77.5	0.344	(graph)	0.975	1.53
Liquid	312 (CT)	77.5	0.3528		1	1.57++

If the specific heats in the gaseous state had been determined at 312° (as in the liquid state) they would have been less, so that the last value, 1.57, should be 1.57++.

Carbon Dioxide. CO_2.

$Tc = 304$
$Pc = 73$
$Sc = 0.369$ (liquid)
$p_c = 2.17$

TABLE III.

	T	P	s	specific heat of gas at T. / sp. ht. of liquid at C.T.	
Gas	293	1	.202	.547	1
	,,	30	.267	.723	1.32
	,,	73	.342 (graph)	.927	1.68
Liquid	304	73	.369	1	1.82

Methane. CH_4.

$T_c = 191$

$P_c = 55$

$d_c = .23+$ (By analogy with pentane, etc.)

$p_c = 1.90$

$\frac{s\ (calc)}{p} = s_c(calc) = 3.19$

$s_c(probable) = 1.68$ [Liquid.]

TABLE IV.

	T	P	s	Spec. ht. of gas at T. / sp. ht. of liquid at C.T.	
Gas		1	0.591	0.352	1
		55	0.84 (graph)	0.500	1.42
		30	0.692	0.412	1.17
Liquid	191	55	1.68	1	2.84

(To be Continued.)

CHEMICAL NOTES.—BOTANICAL.

I. ANALYSES OF SOME AUSTRALIAN FRUITS.

By THOS. STEEL.

1. *Eupomatia laurina* R.Br.

This is a tall, Laurel-like shrub bearing urceolate, succulent, sub-acid fruits. Ripe fruits were selected from a plaut growing in Sydney Botannic Gardens, June 11th, 1897.

2. *Ficus macrophylla* Desf. Moreton Bay Fig.

Largely cultivated for shade and ornamental purposes, bears quautities of purple, globular fruits, about 1 inch in diameter. These are much sought after by the Great Fruit Bat or "Flying Fox" which comes into the cities at night to feed on them. From a tree growing at Petersham, near Sydney.

3. The same, from trees in Sydney Domain; in both cases ripe fruit collected in May, 1897.

4 and 5. *Ficus Cunninghamii* Miq. Sydney Botanic Gardens.

Ripe fruit collected May, 1898.

6. *Ficus rubiginosa* Desf.

Unripe fruit from Sydney Botanic Gardens, May, 1898.

7. Edible Fig, purchased in Sydney. For comparison.

8 and 9. *Podocarpus elata* R.Br.

The fleshy fruit-stalks which carry the hard nut-like fruit on top and have given rise to popular statements about Australian cherries with the seed outside. The entire fruit is swallowed by birds, the soft stalks being digested and the hard seed dropped wherever the bird chances to go, thus insuring distribution. The fleshy stalks were separated, pulped and analysed. Of the entire fruit, 47.7 per cent. was stalk and 52.3 seed. The average weight of one stalk was 1.3 gram. Cane sugar was absent, the sugars present being the usual constituents of Fruit sugar, dextrose and levulose. Collected June, 1897, two samples. The pulped fruit-stalks have a fine rich purple colour, soluble in water or spirit, and yielding a brilliant claret coloured liquid which turns blue with alkalies.

The method used in analysing these fruits is described under 'Fijian Wild Sugar Cane" below.

	1	2	3	4	5	6	7	8	9
Dextrose	2.05	5.75	6.77	4.07	3.30	0.30	5.65	2.56	2.00
Levulose	1.70	4.84	5 69	2.97	2.98		4.07	2.59	1.94
Seeds, fibre, pectose, &c.	17.98	20.24	19.88	8.89	10.50	24.37	3.34	39.20	40.65
Ash	1.42	1.90	1.64	1.11	0.97	2.30	0.44	0.84	0.41
Water	76.85	67.27	66.02	82.96	82.25	73.03	86.50	54.81	55.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen				0.16		0.29	0.25		

1. *Eupomatia laurina.*
2, 3. *Ficus macrophylla.*
4, 5. *F. Cunninghamii.*
6. *Ficus rubiginosa* (unripe).
7. Edible fig.
8, 9. *Podocarpus elata* (Fruit stalks).

II. Fijian Wild Sugar Cane.

The banks of the fresh water rivers of Fiji are covered with a dense tangled growth of a long, slender cane. It is called Vico (Pronounced Vitho in Fijian) by the Fijians, but so far as I know, no use is made of it. There are two varieties, red and yellow. Mr. E. Cheel, who examined it in Fiji informs me that botanically he considers it to be a variety of *Saccharum officinarum*, the common sugar cane.

In November, 1885, when the cane was ripe, I made analyses of four samples. For purposes of comparison I give an analysis, made at the same date, of native cane cultivated by the Fijians and known as Anani, also one of a representative sample of introduced cane of the variety named "Honolulu," at that time largely grown in Fiji for the supply of the sugar mills. The native cane, Anani, is apparently indigenous; at any rate it is the variety grown by the natives for a very long time past, before the advent of Europeans. At the time of my residence in Fiji, about 1885-1886, it was preferred by the Fijians for food purposes to any of the introduced varieties, although these were sweeter. This was probably because they had always used it and were accustomed to it. The method of use was to grate the cane to pulp on a piece of rough coral and squeeze out the juice, which was then used for sweetening purposes.

The analyses are as follows:—

The Fruit sugar in these canes consists of about equal proportions of detrose and levulose.

The method of analysis followed was that of diffusion. In preparing the sample of cane for analysis the stalks were quartered lengthwise and one complete section from each stalk was chopped into short lengths which were pulped by passing through a meat mincing machine, the pulp so obtained being well mixed and the requisite quantities quickly weighed off. A known weight of pulped cane was put into a tared flask with sufficient water ,the flask, fitted with a cork and a plain long tube as a return condenser, was placed in a vessel of boiling water and shaken at frequent intervals for one hour. The flask and contents were then cooled and weighed, and the amount of added water thus ascertained. The liquid was then strained off through a fine cotton cloth and analysed. The percentage of fibre and water in the original pulp having been determined and the Sp. Gr. of the diffusion liquid ascertained, the total weight of liquid derived from added water and that in the pulp taken is thus readily found. The liquid being analysed, it is a simple matter to calculate the total constituents present and to compute therefrom the percentages in the original pulp. 200 grammes pulp and about 400 of water are convenient quantities to use.

In examining the fruits mentioned above, they were passed direct through the meat

		Fijian Wild Cane.				Sugar Canes.	
		Red.		Yellow.		'Anani'	'Honolulu'
Soluble in water	Cane Sugar	3.33	1.68	3.16	3.27	10.88	15.08
	Fruit Sugar	1.00	1.68	0.97	0.74	0.52	0.61
	Other organic matter	1.37	1.56	1.71	1.58	1.73	0.80
	Ash	1.35	1.08	1.39	1.11	0.26	0.17
Insoluble	Fibre	22.48	18.46	26.15	27.08	15.54	11.98
	Ash	0.24	0.22	0.35	0.44	0.36	9.32
	Water	70.89	75.80	66.80	66.38	71.52	70.52
		100.66	100.48	100.53	100.60	100.81	99.48
Average weight per stalk. Kilog.		0.38	0.61	0.44	0.51	—	1.51

mincing machine and the diffusion conducted as for cane. 200 grammes pulped fruit and 300 to 350 of water proved suitable proportions. In fruits the direct determination of matter insoluble in water is not always practicable owing to the glutinous nature of the pulp and the imperfect solubility of the pectin bodies. In these, therefore, the total of these constituents was taken by difference which is sufficient for all essential purposes.

III. ROOTS OF DRAGON TREE, *Cordyline terminalis*.

In *Fiji* the long conical roots of the Dragon tree (*Cordyline terminalis*), known by the natives as Vasili dinu (Pronounced ndinu in Fijian) and Vasili tagu (Pronounced tangu in Fijian), are, after roasting, used as food. Prior to cooking, the roots are white and contain a large proportion of inulin which during the process of roasting becomes transformed into the sugar levulose. After roasting, the roots are soft, succulent and black, looking as if they had been soaked in molasses. The dark colour is due to caramelisation of part of the levulose.

		Raw
Soluble in Water	Levulose	3.32
	Ash	0.27
	Inulin, &c.	30.19
Insoluble	Fibre	11.59
	Ash	0.59
	Water	52.98
		98.94
	Weight of root. Kilogs.	1.64

	Roasted. 1	Roasted. 2
Levulose	38.53	40.49
Caramel, &c.	10.85	6.93
Ash	0.58	0.58
Fibre	12.58	14.06
Ash	0.42	0.68
Water	38.00	38.64
	100.96	101.38
	2.08	1.30

It will be noticed that the raw root was found to contain a small proportion of levulose, it also contained numerous raphides but no starch.

Dr. George Bennett (Gatherings of a Naturalist, 1840, p. 397) states that the root of the Ti (*Dracaena terminalis*) contains a large quantity of saccharine matter, from which the natives of Tahiti extract a coarse sugar; they likewise bake and eat the root, from which also a spirituous liquor is distilled. As will be seen from the analyses above the sugar is only present after cooking.

Speaking of the same root, H. S. Cooper (Coral Lands. Vol. ii., 1880, p. 170) says: "In the Friendly Islands, as well as in all other neighbouring groups, great quantities of the *ti* or dragon-tree are found. The root when cooked contains a most extraordinary quantity of saccharine matter; indeed it seems as if it had been boiled in syrup. Rum is distilled from it in the Friendly Islands as well as from the sugar cane."

IV. DEPOSIT OF CALCIUM CARBONATE IN TIMBER OF GEISSOIS BENTHAMI (F. v. M.)

Some time ago I received from Mr. Maiden a specimen of timber of Red Carrabeen, *Geissois (Weinmannia) Benthami* (F. v. M.), coated in places with a rather hard flinty-looking mineral deposit. This is referred to by Mr. Maiden (Forest Flora of N.S. Wales, VI., 1917, p. 208) as being a source of trouble to saw-millers in the Dorrigo (N.S. Wales), where it is known as "flint." It occurs in the heart of the logs and causes injury to the saws. The suggestion is made that the deposit may be siliceous. Chemical examination showed that it consists of pure calcium carbonate. The amount of deposit at my disposal was insufficient to allow of a quantitative analysis, but qualitative tests disclosed no other substance present. A few chips of the timber carrying the deposit, and of the same, in so far as could be seen, quite free therefrom, were submitted to analysis:—

Timber of Geissois Benthami (Air-day).

	Incrusted portion.	Free from visible incrustation
Ash (CO_2 free) ...	11.4	0.97
Lime (CaO)	10.2	0.31
equal to Calcic carbonate	18.2	0.55
Water	—	9.6

I have not noticed any previous record of the occurrence of this substance in a timber, though its existence as crystoliths in the bark of *Ficus* and some other plants

has been noted (H. G. Smith, Journ. Royal Soc. N.S. Wales, xxxix., 1905, p. 29).

V. The Nitrogen Content of Fungi.

In June and July, 1897, I examined a number of Australian fungi for nitrogen. Three of these were freshly collected on the Blue Mountains, N.S. Wales, and identified by Mr. R. T. Baker; others were ordinary dried herbarium specimens from the collections in the Technological Museum, Sydney, given to me by Mr. Baker. The *Polyporus mylittae* C. et M. (*Mylitta australis* Berk.), popularly known as "Blackfellow's bread," was collected at Wentworth Falls, N.S. Wales, and consisted of a sclerote weighing 2416 grams. The results obtained are as follows:—

Percentage of nitrogen in Australian fungi (dry).

Peziza fasciculosa	6.86
Stereum caperatum	1.83
,, *lobatum*	2.40
Polyporus mylittae	0.51
,, *portentosus*	2.47
Hexagona subtenuis	1.16
,, sp.	2.16
Lenzites repandra	1.12
Polystictus flabelliformis	0.70
,, *sanguineus*	2.40
Trametes Muelleri	0.52
,, *lactinea*	2.21
Clathrus cibarius	1.99
Xylostroma giganteum	0.30

X. giganteum really consists of the sterile mycelium of several Polyporaceae, chiefly *P. eucalyptorum* and a species of *Fomes*.

The three fresh specimens, as under, contained respectively of water:—

	% Water
Pepisa fasciculosa	95.9
Clathrus cibarius	93.5
Polyporus mylittae	77.2

The moisture in the herbarium specimens varied from 10 to 15 per cent. *P. mylittae* in its fresh state yielded 0.15 per cent. ash.

In a paper on *P. mylittae* by Mr. J. H. Maiden (Agric. Gaz. N.S. Wales, iv., 1893, p. 909) it is stated to contain no nitrogen in any form. The specimen examined by me certainly contained nitrogen, though by comparison with some of the other fungi the amount is not high.

The method used for the nitrogen determinations was the Kjeldahl-Gunning.

VI. Exudation from Myoporum Platycarpum R.Br.

In January, 1921, there was forwarded to Sydney Botanic Gardens a sample of a dark brown sugary-looking mass which had been found by Mr. P. Webb in a hollow trunk of the above tree at Barton, S. Australia. This was kindly handed to me by Mr. Maiden for investigation. Examination showed it to consist of impure mannitol from which the pure substance could be readily obtained by extraction with hot alcohol, the mannitol crystallising out on cooling.

A similar exudation from a tree of the same species was obtained during the Elder Exploring Expedition to Central Australia. This was analysed by Mr. H. G. Smith, and the results published by Mr. Maiden (Trans. Royal Socy., S. Aust., xvi., 1892, p. 1).

For the analysis of the Barton sample I am indebted to my colleague, Mr. E. F. Vaughan. For the purposes of comparison I have placed the figures of both analyses together:—

	Elder Expedition. Cent. Australia.	Barton S. Australia.
Mannitol	89.65	44.0
Reducing sugar	2.87	5.4
Other sugars	0.51	—
Gums, insoluble, &c.	2.37	40.8
Ash	1.10	1.9
Water	3.50	7.9
	100.00	100.0

The exudation is known to occur from punctures made by insects.

The Barton sample resembled lumps of coarse raw cane sugar and contained somewhere about 10 per cent. of insoluble matter, principally vegetable debris. It had evidently undergone some deterioration. Barton is a station on the East-West Railway Line crossing the Australian desert.

(From the Proceedings of the Linnean Society of New South Wales, 1921, Vol. xlvi., Part 4, 26th October, 1921.—By favour of the Author).

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

Ordinary Meeting, March 23, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the Summaries here printed having been supplied by the authors for use at the Meeting:—

Sir Richard Glazebrook, F.R.S. Specific Heats of Air, *Steam and Carbon Dioxide.*

In a recent number of the "Proceedings of the Society" is a paper by Mr. Womersley dealing with the specific heats of air, steam and carbonic acid at high temperatures. Mr. Womersley's experiments extend over the range 1000° C. to 2000° C., but he gives a table of the volumetric heats from 0° C. to 2000° C., in which the values below 1000° C. *purport to be those obtained* by Holborn and Henning.

The object of the present communication is to point out that the values here given are in all cases higher by some 5 per cent. to 10 per cent. than those which follow from the results tabulated by Holborn and Henning in their well-known paper in the "Annalen des Physik" for 1907, vol. xxiii., p. 842.

A. E. H. Tutton, F.R.S. (1) Monoclinic Double Selenates of the Manganese Group; (2) Monoclinic Double Selenates of the Cadmium Group.

(1) In this memoir are described the results of the investigation of the crystals of the manganese group of double selenates of the isomorphous series $R_2M(SeO_4)_2 . 6H_2O$. It includes only three salts, those in which R is rubidium, cæsium, and ammonium. For the potassium salt has not been obtained, and appears, like its sulphate analogue, to be incapable of existence. The ammonium salt was measured by Topsøe, but not optically investigated, and the rubidium and cæsium salts have not been hitherto described at all.

The results are precisely in line with those for the analogous salts of the other groups which have been dealt with by the author in previous memoirs, so that if the potassium salt could be obtained there could be little doubt that it would fall into line as the first member of a progressive series, and that the general law of progression of the crystallographic properties with the atomic number of the alkali metal would be obeyed as rigidly as in the other groups already described. It is possible, indeed, to predict the properties which the potassium salt would possess.

Ammonium manganous selenate hexahydrate proves to be almost exactly isostructural with rubidium manganous selenate, *the volume and edge-dimensions* of the space-lattice cells of the crystal structures of the two substances being very nearly identical. A similar fact has been shown to obtain for all analogous ammonium and rubidium salts throughout the whole isomorphous series, as well as for the rhombic simple sulphates themselves.

(2) This cadmium group has proved a very difficult one. Crystals of the ammonium salt $(NH_4)_2$ Cd $(SeO_4)_2.6H_2O$, were measured by Topsøe, but no optical investigation was possible as the crystals were "porcelain like." After very many attempts some crystals have been obtained by the author on very keen frosty nights, which were sufficiently transparent in parts for optical use, and by adopting a rapid method, similar to that used for the equally difficult potassium ferrous selenate, a complete determination of the optical constants has been accomplished. The potassium salt, however, has resisted all efforts, and appears incapable of existence (its limit being probably below 0° C.), like its sulphur analogue. For a long time also no crystals of the rubidium or cæsium salt could be obtained, but eventually during the coldest nights of January a few crystals were obtained among others with different water of crystallisation. They were quite opaque however, from the first, so that only goniometrical measurements were possible.

The results, as far as they go, are in complete accord with those derived from other, complete, groups, as in the case of the manganese group described in the preceding memoir.

This communication completes the great work which the author set before himself in the year 1890, namely ,a thorough crystallographic investigation of the two most important series of isomorphous salts, the rhombic sulphates and selenates of the alkalies and the monoclinic hexahydrated double sulphates and selenates containing the same alkali bases, potassium, rubidium, cæsium, ammonium and thallium. Seventy-five salts have been investigated, the work having involved over forty-five thousand

goniometrical measurements, five hundred density determinations, and the preparation and use in the optical measurements of over *a thousand section-plates and 60°-prisms.*

F. A. Freeth. The System: Na_2O—CO_2—$NaCl$—H_2O. Communicated by *Prof. F. G. Donnan, F.R.S.*

The above system is arbitrarily considered as being composed of two four-component systems, namely:—

Na_2CO_3—$NaHCO_3$—$NaCl$—H_2O.
Na_2CO_3—$NaOH$—$NaCl$—H_2O.

Determinations have been made at eight different temperatures, namely, 0°, 15°, 20°, 25°, 30°, 35°, 45° and 60° C.

A general treatment is given showing how the composition and quantities of the stable phases which are formed from any mixtures whatsoever of the components may be deduced.

M. A. Catalan. Series and other Regularities in the Spectrum of Manganese. Communicated by Prof. A. Fowler, F.R.S.

Flame-arc, arc and spark spectra of manganese have been experimentally observed and series lines traced additional to those prevously known. Series belonging to the spectrum of the neutral atom are (1) a system of triplet series (sharp, diffuse, principal and fundamental); (2) a system consisting of narrow triplets (sharp, diffuse, principal); and (3) a system of narrower triplet series running parallel to the preceding system. The last two systems are analogous to the singlet systems in the alkaline-earths. *Intercombination* lines between the two first systems, $1S-1p_{2,3}$, have bee detected as two lines very prominent at low temperatures. The ionisation and resonance potentials of manganese, as calculated from 1S and $1S-1p_2$ are 7.4 volts and 2.3 volts respectively.

In the spectrum of the ionised atom no series have yet been traced, but there are indications of two systems of triplet series of same types as found in the arc spectrum. In each case the diffuse triplets are composed of *nine* lines, giving *five* values to the d term, instead of *six* lines and *three* values as in the alkaline-earths.

By observations of spectra at different temperatures, groups of lines of the same character and related by very exact numerical separations have been identified, and the name "multiplets" is suggested for these groups. Such multiplets have also been noted in other spectra, and may serve to indicate the most probable nature of series in spectra where actual series have *not* been traced.

The spectrum of manganese in relation to the periodic table is discussed. It seems possible that the neutral atom has two electrons in the outermost ring, and that when it loses one electron, thus becoming ionised, another electron comes out to this ring, which again possesses two. Thus, the spectra of neutral and ionised atoms would be similarly constituted, in accordance with observations.

D. W. Dye, B.Sc. Calculation of a Standard of Mutual Inductance and Comparison of it with the similar Laboratory Standard. Communicated by Sir J. Petavel, F.R.S.

A copy of the Campbell type of Mutual Inductance Standard *has been constructed* by Mr. R. W. Paul for the Japanese Government.

The windings of the primary helices and the secondary overwound coil were carried out at the National Physical Laboratory. The length measurements of these windings were made in terms of the length standards of the Laboratory. From these measurements and the numbers of turns in the windings the value in absolute millihenries has been calculated, taking account of the small irregularities of the windings.

Comparisons between this standard and the similar Laboratory standard have been made at a frequency of ten cycles per second.

The ratio of the calculated values of the two standards was found to be in agreement with the ratio of the experimentally compared values to an accuracy of five *parts in a million.*

The probable accuracy of the value calculated from dimensions was estimated as 2 parts in 10 .

Curves are given showing dimensions and irregularities of the windings and of the variations in mutual inductance with variations in the dimensions of the windings.

P. E. Shaw and N. Davy. The Effect of Temperature on Gravitative Attraction. *Communicated* by *Prof. E. H. Barton,* F.R.S.

One of the writers (*see* Shaw, "Phil. Trans.," May, 1916) has already published results with a torsion *balance of the Boys-*Cavendish type, which indicated a temperature effect of gravitation of about 1×10 per 1° C. The present paper is an account of a new series of experiments identical in principal with the former ones; but the apparatus is now stronger and in some respects more elaborate than the old one. *It has been modified in this way to eliminate*, if possible, any small mechanical movements in the apparatus which may be caused by the raising of the large gravitative masses to a high temperature. If these movements were *reversible with temperature*, spurious effects might arise which would account for the previous results.

The experiments have been successful in the sense that the modifications in the aparatus have shown that most, or all, of the effect found in the previous research was indeed due to such reversible movements. The temperature effect, if any exist under the conditions of the experiment, is now given as less than 2×10 per 1° C. The mean effect now observed is a very small diminution in attraction as *temperature rises*.

A cablegram was read from Prof. J. C. McLennan stating that he had observed accompanying the ordinary red lithium doublet, a second doublet, 0.28 Angström units to the violet—three times the displacement predicted by Merton for the lithium isotopes.

THURSDAY, MARCH 30, 1922.—At 4.30 p.m.—Papers Read.—The late W. G. Ridewood, D.Sc. Observations on the Skull in Fœtal Specimens of Whales of the General *Megaptera and Balænoptera*. Communicated by Prof. E. W. MacBride, F.R.S.

W. L. Balls. Further Observations on Cell-Wall Structure as seen in Cotton Hairs. Communicated by Dr. F. F. Blackman, F.R.S.

L. T. Hogben and F. R. Winton. The Pigmentary Effector System. I.—Reaction of Frog's Melanophores to Pituitary Extracts. Communicated by Prof. E. W. MacBride, F.R.S.

Agnes Arber, D.Sc. On the Development and Morphology of the Leaves of Palms, Communicated by Prof. F. W. Oliver, F.R.S.

H. E. Roaf. The Acidity of Muscle during Maintained Contraction. Communicated by Sir Charles Sherrington, P.R.S.

List of probable papers for reading, April 6th, 1922:—

F. E. Smith, F.R.S.—On an Electromagnetic Method for the Measurement of the Horizontal Intensity of the Earth's Magnetic Field.

G. I. Taylor, F.R.S.—Stability of a Viscous Liquid contained between two Rotating Cylinders. *Part I.: Theoretical.* Part II.: Experimental.

Prof. T. H. Havelock, F.R.S.—Dispersion Formulae and the Polarisation of Scattered Light: With Application to Hydrogen.

G. R. Goldsbrough, D.Sc.—The Cause of Encke's Division in Saturn's Ring. Communicated by Prof. T. H. Havelock, F.R.S.

C. Spearman.—Correlation between Arrays in a Table of Correlations. Communicated by Prof. L. N. C. Filon, F.R.S.

Dr. W. L. Balls.—Apparatus for determining the Standard Deviation Mechanically.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY, 6TH APRIL, 1922, AT 8 P.M.—The following papers were read:—

Constitution of picroroccellin, a nitrogenous constituent of *Roccella fuciformis*.—M. O. Forster and W. B. Saville.

The determination of surface tension from the maximum pressure in bubbles.—S. Sugden.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

PASTEUR CENTENARY, STRASBOURG—MAY-OCTOBER, 1923.

In order to commemorate the Centenary of the birth of Pasteur, the University and the town of Strasbourg, with the concurrence of the Pasteur Institute, and the approval of the family of Pasteur, have proposed to erect a statue facing the Strasbourg University where, as a professor, Pasteur commenced his career.

The inauguration ceremonies will take place on May 1st, 1923, under the Patronage of M. A. Millerand (President of the Republic), M. le Président A. Loubet, M. R. Poincaré, M. Loredu and M. Alapetite, and will include the unveiling of the statue, and the opening of an Exhibition of Hygiene and Bacteriology. This Exhibition

will be designed to illustrate the advances made in various branches of science as the result of Pasteur's discoveries, and at the same time, a Congress of Hygiene and Bacteriology will be held for the discussion of questions relating to the prevention of disease.

With the object of showing the sympathy of this country with the projects of the French Committee, a British Committee composed of the following members has been formed:—

Sir Charles Sherrington, G.B.E., President of the Royal Society (Chairman).

Mr. A. Chaston Chapman, F.R.S., President of the Institute of Chemistry of Great Britain and Ireland (Treasurer).

Mr. H. E. Field, President of the Institute of Brewing.

Prof. Percy F. Frankland, C.B.E., F.R.S., Emeritus Professor of Chemistry, University of Birmingham.

Sir John M'Fadycan, M.R.C.V.S., LL.D., Principal of the Royal Veterinary College.

Prof. C. J. Martin, C.M.G., F.R.S., Director of the Lister Institute.

Sir W. J. Pope, K.B.E., F.R.S., Professor of Chemistry, University of Cambridge.

Sir James Walker, F.R.S., President of the Chemical Society.

Sir Almroth Wright, K.B.E., F.R.S., Principal of the Institute of Pathology and Research, St. Mary's Hospital.

It is hoped that those who desire to contribute to the Memorial will send their contributions to the General Secretary and Treasurer, Monsieur Th. Héring, 6, rue des Veaux, Strasbourg; or to Mr. A. Chaston Chapman, F.R.S., The Institute of Chemistry, 30, Russell Square, London, W.C.1.

The Commissioner-General, Professor Borrel, is very anxious to be furnished with the names of manufacturers and business firms in this country to whom the Exhibition might be of especial interest. All who can assist are requested to communicate with Professor Borrel, 3, rue Koeberle, Strasbourg.

ROYAL INSTITUTION.—Lectures at the Royal Institution after Easter will be resumed on Tuesday, April 25, when Sir Arthur Keith will begin a course of three further lectures on "Anthropological Problems of the British Empire," Series II., "Racial Problems of Africa." The Tyndall lectures will be delivered this year by Prof. W. Bulloch on "Tyndall's Biological Researches," and "The Foundations of Bacteriology," and Sir Percy Sykes will give two lectures on Persia. On Thursday afternoons there will be two lectures by Prof. E. H. Barton on 'Audition and Colour Vision"; two by Prof. F. Keeble on "Plant Sensitiveness." On Wednesday, May 24, Dean Inge begins a course of three lectures on "Theocracy"; and on Wednesday, April 24, Prof. D. H. MacGregor gives the first of two lectures on "Industrial Relationship." On Saturday afternoons there will be two lectures by Prof. C. W. Richardson on "The Disappearing Gap between the X-ray and Ultra-Violet Spectra," and three by Sir Hugh Allen on "Early Keyboard Music," with musical illustrations by Mr. Harold Samuel. The Friday Evening Discourses will be resumed on April 28, when Dr. Arthur Harden will deliver a be given by Dr. M. Grabham, Dr. H. H. Dale, Sir William Bragg, Prof. W. E. Dalby, the Hon. Maurice Baring Mr. J. Barcroft, and other gentlemen.

THE INSTITUTE OF METALS.

A ballot for the election of members and student members of the Institute of Metals will be held at noon on Wednesday, April 19th, in connection with the Twelfth Annual May Lecture. This Lecture is to be delivered on Wednesday, May 3rd, by Professor Sir Ernest Rutherford, F.R.S., of Cambridge University, on "The Relation of the Elements." Membership Application Forms and cards of invitation to the Lecture may be obtained on application to Mr. G. Shaw Scott, M.Sc., the Secretary of the Institute of Metals, 36, Victoria St., London, S.W.1.

THE OPTICAL SOCIETY.

The next meeting of the Optical Society will be held at the Imperial College of Science and Technology, South Kensington, at 7.30 p.m., on Thursday, 6th April, 1922, when the following papers will be presented and discussed:—

"Diffraction halos in normal and glaucomatous eyes," by H. H. Emsley, B.Sc., and E. F. Fincham.

"The effect of changes of curvature at the focus of an astronomical object glass," by E. Wilfred Taylor.

ROYAL MICROSCOPICAL SOCIETY.

A meeting of the Society will be held in the Lecture Hall, 20, Hanover Square, on Wednesday, 19th April, 1922, at 7.30 for 8 p.m., when the following papers will be read:—

Mr. Conrad Beck, C.B.E., F.R.M.S., "The Photometry of a Bull's-Eye Lens for Illuminating Microscopic Objects."

Dr. S. C. Harland, D.Sc., and Mr. J. H. Denham, M.A., F.R.M.S. (The British Cotton Industry Research Association), "The Use of the Microscope in Cotton Research."

Dr. R. S. Ludford, Ph.D., B.Sc., F.R.H.S., F.R.M.S., "The Morphology and Physiology of the Nucleolus."

Mr. Herbert Sutcliffe, A.R.C.Sc., F.L.S., F.R.M.S. (Rubber Growers' Association), "The Use of the Microscope in the Rubber Industry."

CHEMICAL NOTICES FROM FOREIGN SOURCES

DETERMINATION OF SULPHUR IN IRON PYRITES — *G. Chaudron and G. Juge-Boivard.*—Iron disulphide $Fe\ S_2$ exists in two forms, cubic pyrites and marcassite or white pyrites, which crystallises in the thrombic system. Iron pyrites often contains considerable quantities of copper and zinc sulphide. The authors have studied its behaviour when subjected to the action of various liquids, such as concentrated nitric acid, and nitric acid containing three times its volume of concentrated hydrochloric acid, working at different temperatures. They have found that the action of aqua regia and concentrated nitric acid is always the same if pyrites is used. With marcassite at the ordinary temperature no sulphur separates, but at about 70° it is formed. Specimens of pyrites containing copper and zinc sulphides are very readily attacked by nitric acid and aqua regia. Sulphur is separated when the temperature exceeds 60°. If the reaction is carried out in the cold the sulphur is totally oxidised.—(*Comptes Rendus*, CLXXIV., No. 10, 1922).

REDUCTION OF ETHYL BENZOATE AND OTHER BENZENE DERIVATIVES BY SODIUM AND ABSOLUTE ALCOHOL—*Hervé de Pommereau.*—When a solution of ethyl benzoate in absolute alcohol reacts with sodium, a solid substance is first formed, but it redissolves slowly on heating. After saponification hexahydrobenzoic acid and a small quantity of a tetrahydrobenzyl alcohol are formed. This latter $C_6H_9CH_2OH$ is a colourless liquid boiling at 188° under 760 mm. It fixes two atoms of bromine giving a urethane which can also fix two atoms of bromine in solution in carbon disulphide. The study of the reduction of benzene derivatives by means of alcohol and sodium (*e.g.*, benzoic acid, benzyl alcohol, phenol, aniline, nitrobenzene, etc.), shows that only the radicals to which a carboxyl group is directly fixed are easily reduced.—(*Comptes Rendus*, CLXXIV., No. 10, 1922).

HYDROGENATION OF QUATERNARY SALTS OF HEXAMETHYLENE TETRAMINE—*Marcel Sommelet and Jean Guioth.*—Hexamethylene tetramine $(CH_2)\ N_4$ resembles the tertiary amines in its properties; for example, it unites with the halogen alcohol derivatives to give quaternary ammonium salts. It is easily hydrolysed by acids, and the quaternary salts show the same property. They are decomposed even by boiling water, giving among other products the aldehyde RCHO corresponding to the residue $R\ CH_2$ existing in the quaternary salt. When a mixture of formic acid and the chlorobenzylate of hexamethylene tetramine is slowly heated, carbon dioxide is evolved, and finally one of the principal products of the reaction is N-dimethylbenzylamine. Possibly the chlorobenzylate is transformed by hydrogenation, so that the chain $C_6H_5\text{-}CH_2\text{-}N\langle^{CH_2}_{CH_2}$ fixes two atoms of hydrogen, the rest of the molecule meanwhile giving ammonia and the methylamines. The authors have studied many quaternary salts of hexamethylene tetramine, in order to see if this new method of preparing a tertiary amine containing two methyl groups attached to a nitrogen atom is generally applicable, and have found that the reaction occurs in every case investigated, though the yields are sometimes poor. It appears that the method is practically useful only in the case of the quaternary salts containing a benzyl gronp.—(*Comptes Rendus*, CLXXIV., No. 10, 1922).

EXTRACTION OF TANNIN—*E. Knape.*—The author has studied the use of certain substitutes for ether in the extraction of natural tannins. He used trichloro-ethylene mixed with alcohol in the proportion of three parts of the former to one of the lat-

ter. Decolouration was effected by shaking with calcined sodium sulphate, and clarification by sulphate of zinc and ferrocyanide of potassium, etc. The separation of the extract was performed by driving off the solvents over a water bath in vacuo and substituting water for them drop by drop. A mixture of the solvents containing 1/5th or ⅓ of water can also be used. If the liquid is shaken and then allowed to settle, two layers are obtained. One contains tannin and alcohol, while the lower contains nearly all the trichloro-ethylene and traces only of tannan. In this process only the upper layer has to be evaporated. Trichloroethylene and acetic acid give analogous results. These solvents have the advantage over ether of being cheaper and less volatile. —(*Chem. Zeit.* XLV., No. 30, 1921).

NOTES ON BOOKS.

Anthracene and Anthraquinone, by E. DE BARRY BARNETT B.Sc. (Lond.), Lecturer in Organic Chemistry at the Sir John Cass Technical Institute. Pp. xii. plus 436. London: Baillière, Tindall & Cox. Price 25/- net.

The monograph, under review, deals with the theoretical side of a very important section of the manufacture of artificial dyestuffs. Up to the year 1868 anthracene was regarded merely as a chemical curiosity, but in that year Graebe and Liebermann made the discovery that alizarin was derived from anthracene. This discovery furnished the clue to the synthesis of the important colouring matter used in the dyeing of "Turkey Red" and formerly obtained from the root of the madder plant. The manufacture of alizarin by the synthetic method was soon established, and as a result of the interest stimulated by this success an enormous amount of research has been carried out in this field, so that, to-day, in addition to the mordant dyestuffs, which are also built upon the anthraquinone nucleus, are commercial products.

The author deals with his subject in a systematic manner, and endeavours to coordinate the work of the many experimenters with considerable success. The hydrocarbon and its homologues and their simple derivatives are first described, then follows a description of anthraquinone and allied compounds together with their simple derivatives; and finally compounds having a more complex structure, containing the anthraquinone ring system, are discussed.

It is unfortunate that more care was not taken over the proof reading and the faulty naming of several substances thereby avoided—for example, on page 129, 1.4.6. trihydroxybenzoic acid should read 1.4.6. trihydroxyanthraquinone. The use of such phrases as "by the action of dilute oleum" (p. 144) does not improve the book. It is doubtful whether the use of Paff's system of formulation can be justified, and though it may have some advantages when making notes or from the lecturer's standpoint, yet it is a shorthand system unsuited to works of such a permanent nature as a monograph.

However, the book will be very useful to those interested in this subject, and we should like to suggest that, in a future edition, the year be given when quoting references so that the reader may follow the development of the subject with greater ease, and further that the "Index to German Patents" be extended so as to include references to the English Patent literature and also to Friedländer's "Fortschutte der Teerfarbenfabrikation."

F. L. S.

Applied Calculus, by F. F. P. BISACRE, O.B.E., M.A. (Cantab.), B.Sc. (Lond.), A.M.Inst.C.E. London: Blackie and Son, Ltd. 1921. Pp. xv. plus 446. Price 10/6 net.

Science students frequently find it difficult to acquire a sound working knowledge of the Calculus. In this text-book, written especially for science and engineering students, the author has presented his subject in a most attractive manner. Only a very elementary mathematical knowledge, including trigonometry up to the formulæ of sines, is assumed. A simple yet adequate introductory chapter prepares the student for the general principles which are presented and developed in an interesting way. Simple practical illustrations and apt quotations from such remote sources as the Old Testament and Shakespeare, as well as from the writings of mathematicians and philosophers, are introduced to maintain a keen interest in the subject.

When the student has worked through the examples in the sections on the various practical applications, he will be in a posi-

tion to use and understand the use of the Calculus for dealing with problems in *Physics and Physical Chemistry*. For instance, in the chapter on Problems in Chemical Dynamics, the author shows the way to determine whether a particular gas reaction is mono- or bi-molecular, etc. In further examples, data on the decomposition of arsine and of phosphine are supplied, and from these the student is given certain expressions to calculate, and draw his own conclusions. Some of the examples given and exercises set, are taken from original scientific communications, and the exercises at the end are selected from examination papers.

A istinctive feature of this book is the inclusion of portraits and stimulating biographical notes, not only of distinguished mathematicians, but also of physicists and physical chemists.

REVIEWS BY GERALD DRUCE.

ALCHEMY: ANCIENT AND MODERN.—Being a brief account of the alchemistic doctrines, and their relations to mysticism on the one hand, and to recent discoveries in physical science on the other hand; together with some particulars regarding the lives and teachings of the most noted alchemists. By H. Stanley Redgrove, B.Sc., F.C.S. Pp. XX. plus 141 plus 16 plates. London: William Rider & Sons, Ltd., 8, Paternoster Row, E.C. 4, 1922. Price 7/6 net.

It is much to be regretted that chemists have devoted so little attention to the early history of their science, in connection with which so many questions of interest and importance arise. To this new and revised edition of Mr. Redgrove's book—almost the only work on this subject in English, and certainly the best with which we are acquainted in any language—we extend a very hearty welcome. Mr. Redgrove combines a comprehensive grasp of chemical theory with sympathy for the philosophical attitude of the alchemists, a combination essential to the present study, but unfortunately by no means common. He gives an adequate survey of alchemical theory and method, shows how it arose as a result of philosophising by *a priori* method, and exhibits its achievements and failures. The lives and teachings of the leading alchemists are sketched and very interesting lives many of them are. The transformation of alchemy into chemistry is then depicted, and, finally, modern theories concerning the nature of the elements and the possibility of transmuting them are very satisfactorily dealt with. Mr. Redgrove exhibits special ability in bringing into relation with each other the old-time speculations and the latest achievements in chemical theory, showing on the one hand how it is now possible to regard the views of the alchemists with greater sympathy than was the case in the immediate past, and, on the other hand, in what sense it would be an exaggeration to describe these speculations as anticipatory of modern theory. We note that the section of the book dealing with "modern alchemy" has been brought thoroughly up-to-date. The theory of isotopy is admirably explained, and the work of Aston, Rutherford, Soddy and their co-researchers has been adequately dealt with. In the present edition we notice also several minor emendations and improvements. The attractiveness of the book is enhanced by the very fine lithographic reproductions of old portraits of alchemists and of engravings from old alchemical works with which it is illustrated. In a word, this is an admirable and indispensable book, and should be in the library of every serious student of chemistry.

J. G. D.

GENERAL NOTES.

BIRMINGHAM AND MIDLAND INSTITUTE.—An illuminated address and a cheque were presented on Friday, March 24, to Mr. William Russell, F.I.C., on his retirement after 40 years' service as Teacher of Chemistry, first at the Birmingham and Midland Institute, and subsequently at the Municipal Technical School. Tribute was paid to the deep interest taken in the personal welfare of the students by Mr. Russell, to the great value and effectiveness of his teaching, and to the important influence his work had exercised on the training of men in the chemical industries of Birmingham and the Midlands. Dr. W. E. Sumpner presided, and the presentation was formally made by Mr. W. Waters Butler, an old student.

Dyestuffs Importation.—In the House of Commons last week, Mr. Riley asked the President of the Board of Trade if he had received a communication from Thomas H. Daniels, of Belfast, complaining of the refusal of the Dyestuffs Advisory Committee to allow him to import alizarine cyanole violet R. and alizarine brilliant green S.E. powder, the latter of which he stated he could import for 16s. a lb., whereas he was referred to a British firm whose price was 30s. for the same colours but with half the strength; will he verify this complaint?

Sir Philip Lloyd-Greame, Secretary to the Overseas Trade Dept., said: "I have received a communication from the firm mentioned, who I understand are agent for a German dye-making company. Of the applications in question the first was refused by the Dyestuffs Advisory Licensing Committee on the ground that a satisfactory British equivalent for the dyestuff mentioned was available. The applicant then raised the question of the difference in price, and was informed that applications based on that ground could be entertained only when made by the actual consumer. As regards the second case, the question of price difference was not raised by the applicant, who in fact quoted in his application to the Committee the German price as 36s .a lb., and not 16s. as stated by the hon. member. I am not prepared to override the action of the Advisory Committee in this matter."

On March 15th, Mr. Remer was refused leave, by 197 votes to 115, to introduce a Bill to amend the Dyestuffs (Import Regulation) Act, 1920.

Crystallisation of Diamonds. — In a note on the crystallisation of diamonds, Dr. R. J. Sutton, Director of the Kimberley Observatory, S. Africa, refers to the frequent incluson of minerals in the form of either fragments or complete crystals, and suggests that these various inclusions will set up strain and that most diamonds found broken owe their rupture to this cause. Dr. Sutton discredits the accounts of the bursting of natural diamonds, and attributes such strain as is revealed in the polariscope entirely to inclusions. Reference is made to the statement by Sir William Crookes of the explosion of an artificial diamond of microscopic dimensions that had been produced under conditions of great pressure. In this connexion the writer would like to state that he has in his possession a well formed crystal from the Newlands Mine, Kimberley, which shows in the polariscope evidences of very considerable strain and in which there is no appearance of inclusions such as are described by Dr. Sutton.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

6024—Attwater, R.—Method of manufacturing formaldehyde condensation products of phenols. March 1.

6086—Blumenfeld, J.—Production of titanic acid. March 1.

6488—British Dyestuffs Corporation, Ltd.—Separating alkylamines from ammonia, etc., gases. March 4.

6024—Byron, J. G.—Method of manufacturing formaldehyde condensation products of phenols. March 1.

6313—Holdcroft, G. F.—Bleaching fats, fatty oils, and fatty acids. March 3.

6080—Morgan, J. S.—Separating oxygen from atmospheric air. March 1.

Specifications Published this Week.

175,384—White, A. E.—Recovery of gold from pyritic ores.

153,918—Merck, J.—Preparation of tropinone mono-carboxylic acid esters.

155,299.—North, Dr. W.—Production of zirconium.

Abstract Published this Week.

Phenyl glycine compounds.—Patent No. 173,540.—Messrs. H. Levenstein and G. Imbert, of Crumpsall Vale Chemical Works, Blackley, Manchester, have invented a new method of producing tetrachlorethane or trichlorethylene and aniline in aqueous suspension by heating with an alkali such as milk of lime to 140-190° C. until the conversion of the intermediate bodies such as ethylenetriphenyltriamene into phenyl glycine compounds is complete. An autoclave provided with an agitator may be used. After 24 hours' heating, the excess of aniline may be distilled off and the residue cooled and filtered. The solid product may be converted into an alkali salt of phenylglycine, and the small quantity of the calcium salt remaining in the filtrate may be precipitated as the ferrous salt. In another method, ethylenetriphenyl triamine and a caustic alkali or alkaline earth are heated together. Specification 678/06,5013/07, 5014/07, and 13176/07 are referred to. According to the provisional Specification, phenyl glycine anilide may be obtained as an intermediate product in the first method also. alkali, alkali hydrates, carbonates, silicates, aluminates, and zincates are suitable alkalies.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on, post free, for the official price of 1s. each.

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The Editor would be obliged for any information as to the manufacture and supply of "Red Caustic Ash" that was produced in England before the war.

31-3-22.

G. R.

POSTPONEMENT OF SALE.

THE SALE BY AUCTION, Advertised to take place at HARTY FERRY FACTORY, FAVERSHAM, KINGSWORTH, and CLIFFE-AT-NOO, near ROCHESTER, KENT, on TUESDAY, APRIL 4th, and Following Days,

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THE MINISTRY OF AGRICULTURE AND FISHERIES has for disposal, and invites tenders for the purchase of, the contents of an analytical and chemical laboratory, including reagents used in connection with research work at the Rats Research Laboratory, Mount Pleasant, London, E.C.1. There is also a quantity of factory apparatus used for the manufacture of rat bait.

A list of the articles for disposal will be supplied upon application to the Disposal Officer, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Application for permission to inspect the apparatus should be made direct to the Research Chemist at the Laboratory. (Telephone: City 181).

THE CHEMICAL NEWS,
VOL. CXXIV., No. 3235.

THE COAL INDUSTRY.

LESS UNEMPLOYMENT.

The tendency towards a steady reduction in the amount of unemployment in the coal-mining industry is being maintained. The total number of wage-earners on the colliery books at the fortnight ended Feb. 25 was 1,074,662, which represents an increase of 1 per cent. on the figures for a month previous. The percentage of unemployed among the insured workers of the industry on Feb. 21 is given by the *Labour Gazette* as 9.4, which is one of the lowest among the great producing and manufacturing industries of the country.

The average weekly number of days worked in the mines of Great Britain was 5.35 during the fortnight ended Feb. 25. This is an increase of 0.19 over a month ago and 0.71 over a year ago.

BRAZILIAN CENTENARY EXHIBITION.

UNIQUE OPPORTUNITY FOR BRITISH MANUFACTURERS.

To the Editor, "Chemical News."

Sir,—As members of a Committee which has raised £25,000 towards the cost of British participation in the forthcoming International Exhibition, to open at Rio de Janeiro on the 7th September next, we ask for the hospitality of your columns to emphasise the need for making the British Section truly representative of *all* that is best in British industries. We appeal to manufacturers and merchants who possess or hope jto secure connection with Brazil and South America generally to regard this as an occasion of unique historic interest to Brazil, with whom during the last 100 years and more this country has naintained the most friendly relations alike in the sphere of politics and trade.

Every advantage will be taken of this opportunity by other nations whose competition is formidable in this market. The absence on an occasion of this kind of British firms whose names are household words in South America would, therefore, be as damaging to their interests as to the national reputation.

The site allotted for the British building is one of the best in the whole Exhibition, and we are informed from Brazil that the work in its construction is well in advance of that done by other nations. All that is necessary to ensure the complete success of the British Section is that British commercial and industrial firms should consider thei rown ultimate interests and those of this country by maintaining our position in the eyes of the Brazilian people and Government, our friends and allies, whose independence for one hundred years is about to be celebrated.

Any applications made to New Court, St. Swithin's Lane, E.C.4, will receive attention.—Yours truly,

LIONEL DE ROTHSCHILD.
BESSBOROUGH.
E. GORE BROWN.
ARTHUR COOK.
EDWARD GREENE.
W. DOURO HOARE.
FOLLETT HOLT.
C. E. JOHNSTON.
E. R. PEACOCK.
C. D. SIMMONS.
J. O. UNWIN.

POLYMERISATION AT THE CRITICAL TEMPERATURE.

By Wm. R. Fielding, M.A., M.Sc., Vict., Senior Science Master at King Edward VII. School, Lytham.

[NOTE.—The data used in this paper have been taken from Landolt-Börnstein's Tables, and the paper is a continuation of "Polymerisation amongst Liquids," *Chem. News*, 1921, Vol. 122, p. 289.]

(*Continued from Last Week*).

Ethylene. C_2H_4.

$T_c = 283$

$P_c = 51$

$d_c = (1)\ 0.32$
$\quad\ \ (2)\ 0.21$

$p_c = (1)\ 1.51$ (if $d_c = 0.32$)
$\quad\ \ (2)\ 2.27$ (if $d_c = 0.21$)

s_c (calc) $= 2.45$

s_c (probable) $= \frac{2.45}{p}$

$= 1.6$[illegible] (if $p = 1.51$) Liquid
$= 1.08$ (if $p = 2.27$) State.

TABLE V.

	T	P		s		Sp. ht. of gas at T. / sp. ht. of liquid at C.T. (1)	(2)	(1)	(2)
Gas	,,	30		0.450		0.249	0.374	1	1
	379	1		0.404		0.277	0.417	1.11	1 11
	,,	51		0.484	(graph)	0.3	0.448	1.20	1.19
			1	1.62		1		4+	
Liquid	283	51	2	1.08			1		2.67

At 283° the specific heat in the gaseous state will be greater than at 379°; therefore the ratios, 4+ and 2.67 will be less.

The results of Tables II.-V. are summarised in Tables VI. and VII.

TABLE VI.

		Specific heat of gas at C.T. / sp. heat of liquid at C.T.
N_2O		0.97
CO_2		0.92
C_2H_4	(1)	0.30
	(2)	0.45
CH_4		0.5

TABLE VII.

C.T.	p.	Spec. Lt. of gas at CT.	,, ,, ,, Liquid ..	Las ratio Multiplied by the number of atoms (1) in molecule	(2) in polomer
N_2O ..	311	2.28	0.97	2.91	6.63
CO_2 ..	304	2.17	0.92	2.76.	5.99
C_2H_4 .	183	2.27	0.45	2.70	6.13
		1.51	0.30	1.80	2.72
CH_4 ...	191	1.90	0.5	2.50	4.75

For the three substances, N_2O, CO_2, C_2H_4, whose critical temperatures are close together, the products in the last column are not very dissimilar, except when p for ethylene is taken as 1.51. This value was based on $d_c = 0.32$ which seems, therefore, to be wrong. If $d_c = 0.21$ then $p = 2.27$.

This result may be put to another use. p_c for xenon was found to be 2.60 (at 288°).

The Vap. Wt. = 150

$R = 1.15$

s_o (calc) = 0.884

s_c (probable = $\frac{0.884}{2.6}$ = 0.338 (liquid)

$$\therefore \frac{\text{Sp. Ht. of Xenon (gas) at C.T.}}{\text{,, ,, ,, liquid ,, ,,}} \times \text{No. of atoms in molecule} = 2.70.$$

$\therefore$ Sp. heat of xenon (gas) at 288° and under a pressure of 57 atmos. is about 0.913.

$$Or, \frac{\text{Sp. ht. of gas at C.T.}}{\text{,, ,, ,, liquid ,, ,,}} \times \text{No. of atoms in polymer} = 6.13$$

$\therefore$ Sp. heat of xenon (gas) at 288° and under a pressure of 57 atmos. is about 0.798.

NOTE.—At the C.T. (liquid state),

$p_c\, W\, s_c = k$

where p_c is degree of polymerisation.

W = average Wt. of atom.

s = sp. heat.

k = a constant depending on temp.

(See *Chem. News*, Vol. 122, p. 292)

In Table VIII. I have worked out a few results for a number of organic substances.

TABLE VIII.

Subs t.	d_c	T_c	P	Formula Wt.	p
H_2O		647	217.5		
C_2H_5OH	0.2755	516	63	46	1.94
$(C_2O_5)_2$ O	0.26	467	36	74	2.1
CH_3 COOH	0.3506	594	57.1	60	1.57
H_2O		647	217.5		
CH_3OH .	0.2722	513	78.5	32	1.71
C_2H_5OH .	0.2755	516	63	46	1.94
C_3H_7OH	0.2734	537	50	60	1.945
H_2O		647	217.5		
CH_3 C_2H_5O	0.307	441	46.3	60	1.95
(C H) O	0.26	467	36	74	2.1

C_6H_6 ...	0.3045	561.5	47.9	78	2.08		
C_6H_5F ...	0.3541	559.6	44.57	96	2.06		
C_6H_5Cl ..	0.3654	632	44.67	112.5	2.07		
C_6H_5Br	0.4853	670	44.52	157	2.05		
CH_3CN	0.2371	548	47.7	41	1.43		
$C_2H_5.CN$	0.2401	564	41.3	55	1.60		
			53.8		2.08		
HCl	0.61	325	86	36.5	1.51	55.1	54.7
CH_3Cl ...	0.370	416	66	50.5	2.06		

The results given in Tables I. and VIII. agree only occasionally with those obtained from Guye's equation. In many cases they appear to be either the arithmetic or geometric mean between the values at the boiling-point (1 atmos.), and *in the gaseous state (1 atmos.)*. Hydrogen is almost entirely H_2 at the C.T., whereas bromine is Br_3, and the inert elements, argon, krypton, and xenon are polymerised to a surprising extent, consisting of perhaps, A_2 and A_4. The oxides, N_2O, CO_2, SO_2 are almost equally polymerised (2+), whereas water is $(H_2O)_{1 \cdot 34}$ to $(H_2O)_{1 \cdot 5}$ according to the critical density we decide to accept. The monohydric alcohols are more polymerised than water, and p for methyl alcohol seems to be less than for other members of the series. The halogens derivatives of benzene have the same p as benzine itself.

(To be Continued.)

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

Ordinary Meeting, March 30, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

The late W. G. Ridewood, D.Sc. Observations on the Skull in Fœtal Specimens of Whales of the Genera *Megaptera* and *Balænoptera*. Communicated by Prof. E. W. MacBride, F.R.S.

Five fœtal skulls are described—three of *Megaptera nodosa*, one of *Balænoptera borealis*, one of *B. musculus*. The presence of an interparietal bone in some whales, and the meeting of the parietals in a median suture in others, is discussed. The value of these characters in taxonomy is discounted.

Syncondyly is regarded as associated with suppression of the atlanto-epistropheal joint.

There is no separate foramen for the hypoglossal nerve.

The periotic bone shows no separate centres of ossification, but a diffuse endochondral granular deposit. The orbitosphenoid ossifies independently of the presphenoid.

The confusion regarding pterygoid and alisphenoid bones is discussed, and is attributed to a spurious resemblance existing between the air-containing pterygoid fossa of whales and the pterygoid fossa of the ordinary mammalian skull.

In whales there is no "external pterygoid plate" of alisphenoidal origin; the alisphenoid is the ossibed *ala temporalis solely*, with no additional plates of membrane bone. The author failed to confirm Schulte's observation of division of the pterygoid into external and internal.

The suggestion of homology between reptilian parasphenoid and mammalian vomer was made by Smets (1885), independently of Bland Sutton's remarks.

The growth of the malleus is described, and the homologies of the processes, regarded as still in doubt by Turner (1913), elucidated.

The growth of the tympanic bone, and the relations of the great bulla to the primary *annulus tympanicus*, are explained. The ingation of the tympanic membrane, claimed by Lillie (1910) as a discovery, is shown to have been recorded several times previously.

W. L. Balls. Further Observations on Cell-Wall Structure as seen in Cotton Hairs. Communicated by Dr. F. F. Blackman, F.R.S.

The daily growth rings described in an earlier communication ("Proceedings," B, vol. 90, 1919), are shown each to consist of a large number of fibrils, which are spirally arranged, with frequent reversals of the direction of the spirals. It appears that this arrangement is predetermined for the secondary cellulose of the growth rings by the initial pattern laid down in the primary wall during the period of growth in length. The consequent radial super-position of the fibrils in successive growth rings appears to be a general phenomenon, whereof the formation of simple pits in the wall is merely a special case. The individual fibrils have a cross-sectional area of the order of 0.05 square microns, so that this analysis of the wall structure is approaching problems of molecular arrangement. Some of the evidence is suggestive of the existence of stereo-isomerism in cellulose.

L. T. Hogben and F. R. Winton. The Pigmentary Effector System. I.—Reaction of Frog's Melanophores to Pituitary Extracts. Communicated by Prof. E. W. MacBride, F.R.S.

The posterior lobe of the pituitary gland contains a specific stimulant which, if injected into the frog, brings about a condition of general and complete expansion of the dermal melanophores: a dose equivalent to 0.0003-0.0005 cc. of commercial "infundibar" preparations (Boroughs and Wellcome) is sufficient to induce a darkening of the skiu readily visible to the naked eye. The pituitary melanophore stimulant is not destroyed by pepsin or boiling: it is not identical with histamine, since neither histamine nor putrid meat extracts give this reaction. Furthermore, it is rapidly destroyed by trypsin. It is not rapidly destroyed by acid hydrolysis (continuous boiling with with 0.5 per cent. HCl); and in this respect agrees with the oxytocic (uterine) and differs from the pressor principle. After cocaine, curare, atropine and apocodeine it still evokes its characteristic response, and therefore acts probably directly upon the melanophores themselves. The result of the experiments confirms the endocrine significance of the condition of general pigmental contraction found by Allen and others to follow removal of the pituitary gland in tadpoles. If Spaeth's observations are correct, the melanophores of amphibi aand fishes respond in an opposite manner to the pituitary autacoid: the action of the latter is also opposite to that of adrenin in the amphibia.

Agnes Arber, D.Sc. On the Development and Morphology of the Leaves of Palms. Communicated by Prof. F. W. Oliver, F.R.S.

The developmental history and homologies of the members constituting the mature palm leaf have long been subjects of controversy. In this paper a renewed attempt is made to interpret the leaves of this group, on lines which have suggested themselves in the course of the writer's study of the leaves of other Monocotyledonous families. On the evidence of ontogeny and comparative morphology the following conclusions are reached:—

1. The leaf-stalk, which succeeds the basal sheath, is, both in fan- and feather-palms, the basal or proximal region of the true petiole.

2. The "fan" or "feather" limb is not, morphologically, a lamina, but a modification of the distal region of the true petiole. The complex plication of the limb arises through the development of a series of invaginations, which penetrate the leaf-stalk tissue between the bundles.

3. The "ligule" and "dorsal scale" of the fan-palms are not morphological entities, but merely represent adaxial and abaxial distal margins of the uninvaginated proximal region of the petiole. The terms "ventral crest" and "dorsal crest" are proposed as substitutes for the terms "ligule" and "dorsal scale."

4. The palm leaf, regarded as a whole, is on the present interpretation a petiolar phyllode with a pseudo-lamina—a conception which brings it into essential relation with the leaves of other Monocotyledons.

H. E. Roaf. The Acidity of Muscle during Maintained Contraction. Communicated by Sir Charles Sherrington, P.R.S.

Records of electrical changes by a manganese dioxide electrode in combination with a calomel electrode show that:—

1. In a veratrinised muscle the acidity remains as well as the tension.

2. In decerebrate rigidity reflex inhibition is accompanied by a decrease in acidity.

These results indicate that acidity and tension are related, and that a single mechanism is sufficient to account for both tetanus and tone.

THURSDAY, APRIL 6, 1922, AT 4.30 P.M.—Papers read:—

F. E. SMITH, F.R.S. On an Electromagnetic Method for the Measurement of the Horizontal Intensity of the Earth's Magnetic Field.

G. I. TAYLOR, F.R.S. Stability of a Viscous Liquid contained between Two Rotating Cylinders.

PROF. T. H. HAVELOCK, F.R.S. Dispersion Formulæ and the Polarisation of Scattered Light; with Application to Hydrogen.

G. R. GOLDSBROUGH, D.Sc. The Cause of Encke's Division in Saturn's Ring. Communicated by Prof. T. H. Havelock, F.R.S.

C. SPEARMAN. Correlation between Arrays in a Table of Correlations. Communicated by Prof. L. N. G. Filon, F.R.S.

DR. W. L. BALLS. Apparatus for Determining the Standard Deviation Mechanically.

IRON AND STEEL INSTITUTE.

At the Annual Meeting to be held on May 4 and 5, 1922, the following papers are expected to be read:—

C. R. AUSTIN: "Hydrogen Decarburisation of Carbon Steels, with notes on related phenomena."

N. T. BELAIEW: "The Inner Structure of the Pearlite Grain."

N. C. H. CARPENTER and MISS C. F. ELAM: "Effect of Oxidising Gases at Low Pressures on Heated Iron."

F. CLEMENTS: "British Siemens Furnace Practice."

E. W. EHN: "Influence of Dissolved Oxides on Carburising and Hardening Qualities of Steel.

A. F. HALLIMOND: "On delayed Crystallisation in the Carbon Steels: the Formation of Pearlite, Troostite and Martensite."

K. HONDA: "On the Constitutional Diagram of the Iron-Carbon System, based on recent investigations."

K. HONDA and T. KIKUTA: "On the Stepped A 1 Transformation in Carbon Steel during rapid cooling."

D. E. ROBERTS: "Notes on Blast Furnace Filling."

D. SELBY - BIGGE: "Recent Developments in Power Production."

A. WESTGREN and G. PHRAGMEN: "X-ray Studies on the Crystal Structure of Steel."

J. H. WHITELEY: "Formation of Globular Pearlite."

N. YAMADA: "On the Heat of Transformation of Austenite to Martensite, and of Martensite to Pearlite."

THE ROYAL INSTITUTION OF GREAT BRITAIN.

LECTURES AFTER EASTER, 1922.

Friday Evening Discourses addressed to members and their friends at 9 p.m.

April 28: Arthur Harden, D.Sc., F.R.S., Head of Biochemical Department, Lister Institute, "Vitamin Problems."

May 5: Michael Grabram, M.D., F.R.C.P., "Biological Studies in Madeira."

May 12: H. H. Dale, C.B.E. M.D., F.R.S., Head of Department of Biochemistry and Pharmacology under Medical Research Council, "The Search for Specific Remedies."

May 19: Sir William Bragg, K.B.E., D.Sc., F.R.S., M.R.I., Prof. of Physics, University of London, "The Structure of Organic Crystals."

May 26: W. E. Dalby, B.Sc., F.R.S., M.Inst.C.E., Prof. of Engineering, Imperial College of Science and Technology, "The Internal Combustion Engine: Its Influence and its Problems."

June 2: Hon. Maurice Baring, O.B.E., "Gilbert and Sullivan" (with musical illustrations).

June 9: Joseph Barcroft, C.B.E., F.R.S., Fellow of King's College and Reader in Physiology, University of Cambridge, "Physiological Effects at High Altitudes in Peru."

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, 5 APRIL, 1922.—Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President), in the chair.

Papers, of which the following are abstracts, were read:—

"The Constants of Indian Beeswax," by O. D. Roberts, F.I.C., and H. T. Islip, A.I.C.

The paper deals with the examination of a number of samples of Beeswaxes col-

lected in Bengal and Eastern Bengal and Assam under the supervision of District Officers.

The authors have shown that the constants of many of these samples differ very appreciably from those previously recorded for genuine samples of Indian Beeswax.

"Note on the Liver Oil of the 'Tope' (*Galeus galous*), by A. Chaston Chapman, F.R.S., F.I.C.

The author has prepared and has examined the Liver Oil of the Tope, a fish belonging to the Shark family, and gives the Analytical Data which he has obtained.

"Note on the Examination of Foods for the Presence of Sulphites," by A. Chaston Chapman, F.R.S., F.I.C.

The Author points out that in the examination of food products for the presence of Sudphurous Acid or Sulphites by the method usually adopted, somewhat heavy indications may be obtained in the case of products to which no sulphite has been added. He finds that where such products have been flavoured with, or contain substances such as onions or mustard which yield on distillation organic sulphur-containing compounds, the sulphur in such compounds may be wholly or partly oxidised by the bromine water to sulphuric acid, and the analyst may in consequence be led wrongly to infer the presence of added sulphites. In such cases a differentiation between sulphurous acid and organic sulphur compounds may usually be made by substituting hydrogen peroxide for bromine or iodine in the distillation process.

"Demonstration of Artificial Daylight for Laboratory Purposes" (Sheringham System), by Sydney H. Groom, B.A.

The Exhibitor gave a demonstration to show how the attachment so adjusted the rays from an ordinary gas filled electric globe as to give a light by which Colours have the same value as when viewed by daylight, and suggested how indicators, unworkable by artificial light, might be operated with this corrected illuminant.

"Certain Tropical Oilseeds," by E. R. Bolton, F.I.C., and D. G. Hewer, B.Sc.

The authors describe the following nuts and seeds, with suggestions as to the uses of the fats and oils they contain. Analytical data are given in each case: *Platonia insignia*, Andirobinha, *Baillonella sp.*, species of *Parinarium* seeds, *Theobroma gran-* [illegible] *Theobroma bicolor.*

SOCIETY OF CHEMICAL INDUSTRY.

BIRMINGHAM AND MIDLAND.

A meeting of the Birmingham and Midland Section was held at the Birmingham University Buildings on March 30, Dr. H. W. Brownsdon presiding. The following were the elections for the ensuing year:—

Dr. Ed. B. Maxted, Chairman; Professor Gilbert T. Morgan, D.Sc., M.Sc., O.B.E. (Chemistry Dept., University of Birmingham), and Mr. F. R. O'Shaughnessy, who has been for 17 years hon. sec. and treasurer of the section, which he was largely responsible for establishing, Vice-Chairmen; and Mr. G. King, hon. sec. and treasurer. On the motion of Professor A. R. Ling (Brewing Dept., University of Birmingham), seconded by Prof. Morgan, a vote of thanks was passed to Mr. O'Shaughnessy for his long and excellent service. Dr. Brownsdon said he would reserve his tribute to a later date.

ACTION OF AMMONIA ON REDUCING SUGARS.

An interesting paper, on (a) "The Actior of Ammonia and of Amino-Compounds or Reducing Sugars"; and (b) "The Actior of Ammonia on Dextrose and Lævulose,' was read before the members of the Bir mingham and Midland Section of the Society of Chemical Industry on March 30 by Dr. Arthur R. Ling and Mr. Dinshav Rattonji Nanji, of the Dept. of the Bio chemistry of Fermentation.

Mr. Nanji pointed out that this investi gation was originally undertaken to thro some light on the mechanism of the re actions which occur in the manufacture c so-called caramel by the ammonia process When ammonia is brought in contact wit dextrose (fused or in aqueous solutior either in the form of gas or aqueous solu tion, at a moderate temperature—say 35 40°—combination of the ammonia wit the sugar takes place. If, now, the liqu be heated to a higher temperature, e.g 100°, a vigorous exothermic reaction e sues, and there are produced dark colour substances. Similar reactions occur whe certain amino-compounds are substitut for ammonia. The production of colour malt by the kilning process is due to a com bination between the amino acids and t reducing sugar produced during germin tion, and the subsequent decomposition these compounds when the malt is rais to a higher temperature on the kiln. T present experiments refer to the first sta

of the reaction between dextrose and lævulose respectively, and ammonia and the nature of the resulting compounds. When an excess of ammonia acts on dextrose at a temperature of about 35°, an additive compound is formed, being the analogue of aldehyde-ammonia, namely, glucose-ammonia. The solution was tested for amino-compounds with negative results. The presence o fthe aldehyde hydrate will decide the course of the reaction between dextrose and ammonia in aqueous solution. The ammonia, it may be assumed, combines with the elimination of one molecule of water. When to a solution of dextrose containing 20 grams of that sugar in 100 cc. concentrated ammonia is added in quantity amounting to just above one molecular proportion, in relation to the dextrose, and the solution is heated at a temperature ranging from 35-60°, it is found that the specific rotatory power is that of the usual mixture of glucose in equilibrium. When the heating is continued, the rotation still falls the more rapidly as the temperature approaches the higher limit. As the reaction proceeds the aldehyde hydrate is removed from the solution as glucose ammonia, and the equilibrium thus disturbed is restored by the conversion of more of the glucose with the aldehyde hydrate. Thus in the presence of an excess of ammonia the reaction proceeds to the point of complete conversion of the dextrose into glucose-ammonia. The experiments showed, however, that this reaction is a reversible one, and that the glucose-ammonia in solution dissociates, a certain equilibrium being probably established at any one temperature between the glucose-ammonia and the sugar present, the sugar obtaised from the glucose-ammonia is not the aldehyde form. Glucose-ammonia reacts as an aldehyde towards alkaline solutions of some of the heavy metals: thus a mirror of metallic copper is formed in the cold when a solution is added to Fehling's solution or to ammoniacal silver nitrate solution. It does not, however, give Schiffs' reaction.

A more thorough examination of the sugar obtained by the action of ammonia on dextrose showed that besides aldose it also contained a ketose. It was found that ammonia reacts with lævulose soldtions much more vigorously tban with dextrose solutions at temperatures above those of the ordinary room. The reaction in the case of lævulose is accompanied hy instantaneous darkening and decomposition. The product obtained from lævulose decolourised permanganate just as that from dextrose. It was evident that by the action of ammonia on either dextrose or lævulose a mixture in equilibrium of aldoses and ketoses is obtained. Their experiments showed that by the action of ammonia on dextrose or lævulose respectively, NO MANNOSE is formed, whereas Lobry de Bruyn and Van Ekenstein invariably obtained a small quantity of that sugar which is readily identified by the insolubility of its phenyl hydrazone. The explanation of this was receiving their attention.

The authors summarise the position thus: (1) Dextrose unites with ammonia at a temperature of 35° to form an additive compound glucose-ammonia. This compound reduces alkaline copper and silver solutions with the formation of a metallic mirror. It exists in solution in a state of dissociation, for the specific rotary power is the same as that of the sugar freed from ammonia.

(2) An aqueous solution of the sugar obtained from glucose-ammonia in the form of a syrup reduces potassium permanganate at the ordinary temperature. (3) The sugar consists of a mixture of aldose and ketose in equilibrium, the equilibrium being changed according to reaction of the solutions. In a solution in $N/_4$ H Cl, 100 per cent. of aldose is present.

(4) Lævulose, when treated with ammonia, is partially converted into aldose, and this unites with ammonia. Possibly when the rotatory power has fallen to its lowest limit, complete conversion into aldose has taken place. The solution behaves in every way similar to the product from dextrose.

(5) When the ammonia is removed from this product a mixture of aldoses and ketoses in equilibriu mis obtained.

Professor Ling added that the work was being continued.

A Micro-Kjeldabl Method of Estimating Nitrogen.

Professor A. R. Ling and Mr. W. J. Price (Brewing Dept., University of Birmingham), read an interesting paper before the members of the Birmingham and Midland Section of the Society of Chemical Industry, on March 30, on "A Micro-Kjeldahl Method of Estimating Nitrogen." Mr. Price explained that in conducting experimenta investigations in biochemistry it is desirable to be acquainted with some re-

liable method of estimating hydrogen which requires the minimal quantity of material for each determination. The Kjeldahl method in its most approved form is one of applied applicability, and, moreover, it is known to which classes of compound it can be applied. The fact, however, that nitrogen in some states of combination in which it exists in organic compounds, cannot be estimated b ythe Kjeldahl method, is one which must be borne in mind. Among the nitrogenous substances which the biochemist has to handle, the great majority are amino or imino compounds, the nitrogen content of which can be estimated accurately by the Kjeldahl method. Their object was, therefore, to determine if a modification of the Kjeldahl method could be devised, requiring quantities of substance for each estimation containing nitrogen from 1.0—0.1 mgrm. The purpose of which they required a micro-Kjeldahl method was for the estimation of nitrogen in substances containing but a trace of protein and much carbon, e.g., starch preparations and othe rcarbohydrates. In order to come within the range in which they worked, it was necessary to take a weight of carbohydrate amounting to 0.3-0.5 gram. Several experiments were carried out, using a mixture of phosphoric acid, sulphuric acid, and copper sulphate as directed by Folin and Denis. This procedure had, however, ultimately to be abandoned, owing to the difficulty encountered by the attack on the glass tubes. They were unable to obtain any glass which would withstand the action of the acid mixture, even when the phosphoric acid was reduced to the lowest limit. In the next series of experiments the weighed portion of the substance was heated in a boiling tube of hard glass for about five minutes with about 8 cc. of concentrated sulphuric acid until it charred. The liquid was then cooled ,about 1 gram of potassium persulphate was added, and the heating continued until the liquid was colourless. After cooling, 40 per cent. sodium hpdroxide solution was added carefully, till the liquid was faintly alkaline, and 5 cc. of the Nesler reagent. The liquid was then made up to 250 cc. and its tint compared with that of a standard solution of ammonium sulphate containing the equivalent of 1 mgrm. of nitrogen in 250 cc. The Kjeldahl solution prepared in this manner was invariably cloudy owing to the presence of electrolytes, and it was therefore impossible to compare its tint with that of the standard solution. In order to obviate this difficulty it is necessary to distil the solution. With regard to the use of persulphate, this undoubtedly expedites the reaction which by its use can be reduced to about 30 minutes. The method finally adopted was as follows: An accurately weighed portion of the substance containing 1—0.1 mgrm. of nitrogen is introduced into a hard glass boiling tube, together with 1 grm. of dry potassium sulphate and 0.02 grms. of anhydrous copper sulphate, 8 cc. of concentrated sulphuric acid is then added and two drops of 2.5 per cent. platinum tetrachloride solution. A small funnel is placed in the mouth of the tube, and the contents are boiled gently until the liquid is colourless. In the case of carbohydrates this occupies about one hour. The liquid is then allowed to cool, about 15 cc. of distilled water added, and the diluted liquid boiled to expel any sulphur dioxide. Attempts to deal with the liquid direct were unsuccessful, and we found it necessary to distil. When cold, the liquid is introduced into a 300 cc. distilling flash, fitted with a tap funnel and connected with a Liebig's condenser by the side tube. The further end of the condenser is fitted with an adaptor, the end of which dips into about 50 cc. of water contained in a graduated 250 cc. flask. A few pieces of freshly ignited porous porcelain, free from nitrogen, are added to the flask to prevent bumping, and a small stri pof litmus paper. Forty per cent. hydroxide is added through the tap funnel until the contents of the flask are alkaline. Distillation is now commenced and continued until all the ammonia has passed over. It is necessary to distil about 100 cc. To the distillate 1.5 cc. of 40 per cent. sodium hydroxide is added, and then 5 cc. of the Nessler reagent, the contents of the flask being well shaken after the addition of the sodium hydroxide and of the Nessler reagent. The liquid is now made up to 250 cc. A stock solution of ammonium sulphate is prepared containing 4,716 grams of that salt and 200 cc. of $\frac{N}{1}$ sulphuric acid (to inhibit the growth of micro-organisms) in one litre. This solution contains one mgrm. of nitrogen per cc. One cc. of this solution is added to about 150 cc of water in a 250 cc. graduated flask; to this is

added 1.5 cc. of 40 per cent. hydroxide solution and 5 cc. of the Nessler reagent, the liquid being well shaken and made up to 250 cc. After allowing 5 minutes in order that the colour may develop 10 cc. portions of each of the two solutions—the Kjeldahl and the standard—are introduced into two small flat-bottomed tubes of colourless glass. In order that the method may yield accurate results, the relation between the degree of colouration by the Nessler reagent and the concentration of nitrogen as ammonia in a given solution, must be established. The Nessler reagent was prepared on the Folin and Denis plan.

LONDON COUNTY COUNCIL.

Scholarships in Art or Science and Technology, 1922.

The Council will be prepared to award in 1922: (a) 25 Technology and Science Scholarships; (b) 23 Art and Artistic Crafts Scholarships.

(1) The scholarships will be tenable for two years at full-time day courses at institutions at which higher instruction in technology, science, art or artistic crafts is given, and may be extended for a third year. They will enable students who are engaged in trades or occupations, and have attended evening classes for at least two years, to give up their day-work and pursue a course of advanced instruction in Engineering, Building, Chemical Industries, Printing, Motor-body Building, Leather and Furnishing Trades, Artistic Crafts, etc. Of the 23 art scholarships, 13 will be offered in general art courses, and 10 will be reserved for persons employed in artistic crafts.

(2) In some cases a maintenance grant, assessed on the merits of each individual case, will be provided, but it will not exceed £160 a year. Scholars will be required to pay their own incidental expenses, including examination fees, modelling expenses, books, apparatus, etc.

(3) Candidates must be British subjects, and their parents (or guardians) must reside in the administrative County of London unless the candidate is over 21 years of age on 31st July, 1922, and is self-supporting, in which case he (or she) must be ordinarily resident in London. They must be not less than 18 years of age on 31st July, 1922, and must have made at least 200 hours' attendance at a polytechnic, technical institute, or school of art in the sessions 1920-21 and 1921-22. They must have made at least 80 per cent. of possible attendances in the latter session, ending 31st July, 1922. Allowance will be made for interruption of studies due to illness.

(4) Candidates will be required to submit details of their educational career and attainments and specimens of their work. They will be interviewed, and, if necessary, will be required to undergo a qualifying examination.

Application forms T may be obtained from the Education Officer (T.2a), Room No. 539, New County Hall, S.E.1, and must be returned not later than 1st May, 1922. Particulars of all scholarships offered by the Council appear in the L.C.C. Scholarships Handbook, which may be obtained from P. S. King & Son, Ltd., 2 and 4, Great Smith Street, Westminster, S.W.1, price 3d., or by post 4½d.

R. BLAIR,
Education Officer.

L.C.C. Education Officer's Department,
New County Hall, S.E.1.
January, 1922.

CHEMICAL NOTICES FROM FOREIGN SOURCES

Third International Conference of Chemists.—The Third International Conference of Chemists will take place at Lyons from June 27 to July 2. The President will be M. Grignard, the Director of the School of Industrial Chemistry, and the Vice-Presidents are MM. Fougere, Gillet, Morel and Sisley, while the Secretary is M. Bernard. The general programme as at present arranged is as follows:—

Tuesday, June 27, 9 p.m.—Reception of the Delegates by the Municipality at the Hotel de Ville.

Wednesday, June 28, 9.30 p.m.—Meeting of the Council of the International Union.

10.30 a.m.—General Meeting of Delegates.

2.30 p.m.—Meetings of Committees.

5 p.m.—Tea for the Delegates, given by the President of the International Union.

Thursday, June 29, 9.30 a.m.—Meetings of Committees.

2.30 p.m.—Visits to Factories.

Friday, June 30, 9.30 a.m.—Meetings of Committees.

2.30 p.m.—Visits to Factories.

Saturday, July 1, 9.30 a.m.—Meeting of the Council of the International Union.

2.30 p.m.—General Assembly of the Delegates.

7.30 p.m.—Closing Banquet, given to the Delegates by the Lyons Chamber of Commerce.

Sunday, July 2.—Descent of the Rhone by boat.

Besides the meetings reserved for the representatives of the National Councils of the countries belonging to the International Union of Pure and Applied Chemistry, the general programme includes two important lectures, specially organised for the Lyons technologists. These lectures will be given by MM. Louis Lumiere and Jean Perrin. Many firms have agreed to allow the delegates to visit them, and the final excursion will take the delegates to the neighbourhood of Marseilles, while they will be invited to take part in the second Congress of Industrial Chemistry.

SECOND CONGRESS OF INDUSTRIAL CHEMISTRY.—The second Congress of Industrial Chemistry, organised by the Society of Industrial Chemistry, will take place this year at Marseilles, in the Technical Institute, from July 2 to 7. The President of the General Committee of Organisation and Administration will be M. A. Gardair, and the Vice-President M. A. Gouin, and there will also be a scientific and technical committee, of which the President will be M. Rivals. Among the questions to be specially discussed will be those dealing with the mineral, vegetable, and animal resources of the French colonies.

The general programme includes the following items:—

July 2, 9 p.m.—Reception of the members of the Congress by the Marseilles Committees.

July 3, morning.—Formal opening of the Congress; Lecture; Visit to the Technical Institute.

Evening.—Meeting of the Sections; Lecture.

July 4, morning.—Meeting of the Sections.

Evening.—Visit to the Colonial Exhibition; Technical Discussions in the various Pavilions; Dinner at the Exhibition; Evening Party.

July 5, morning.—Meeting of the Sections.

Evening.—Meeting of the Presidents and Secretaries; General Report; Formal closing Meeting; Lecture; Banquet.

July 6 & 7.—Visit to the works of the port of Marseilles, and factories.

The committee has arranged to issue a series of coupons, which will cover all the expenses at the hotels and restaurants and the banquets and excursions. Those who intend to take part in the Congress are asked to intimate their intention to do so as soon as the definite programme of the Congress is published. The Congress will be divided into groups as before, the Marseilles Technical Institute having placed at the disposal of the Organising Committee a large number of rooms and amphitheatres. Any technologist who has carried out any important researches in the course of the year is invited to make his results known at the Marseilles Congress, and thus to show his interest in this important event in the chemical world.

GENERAL NOTES.

FINE CHEMICALS.

In the House of Commons on Monday, April 3, Dr. Murray asked the President of the Board of Trade whether he was aware that, after exhaustive hearings before the Referee under Part I. of the Safeguarding of Industries Act, it was admitted by his Department, manufacturers, merchants, and scientists, that the term in the schedule, "fine chemicals," could not be interpreted; and if so, what steps he proposed to take to rectify the matter, or whether he proposed to continue the endeavour to enforce the Act?

Mr. Baldwin said that he was unable to accept the proposition laid down in the first parts of the question. The doubts which had arisen related only to a limited number of cases, which were of a border-line character, and provision for dealing with these was made in the Act itself. No further action appeared necessary.

ACETONE.

Major M. Wood asked the President of the Board of Trade if he was aware that acetone for industrial purposes was manufactured by two distinct processes, namely, from acetate of lime and by fermentation process; that both materials were identical; that they tested on analysis exactly the same, and that it was impossible to tell one

from the other; that the former was not liable on importation to duty under Part I. of the Safeguarding of Industries Act, and that the latter was liable; and whether he could state how the liability to duty of such material, when imported, was determined?

Mr. Baldwin said that he was aware that acetone, as sold, might be made by either of the two processes mentioned. The practicability of determinative tests of origin was under consideration, but should these be shown to be non-existent, the liability or non-liability of imported acetone to duty must be determined by such declaration by the importer as the Customs might deem sufficient.

SMUGGLED DRUGS.

Mr. Shortt, the Home Secretary, in answer to Mr. Morris, said that information was received from time to time that opium, cocaine, and other drugs were smuggled into the country, and it was known that Chinese seamen and others were addicted to the opium habit, but the police were not aware of any organised traffic. Every effort was made to detect offenders, but short of opening all incoming passengers' luggage, the minute search of every passenger, and the examination of every postal package, he was afraid that it would not be possible to suppress entirely the illicit introduction of drugs into this country as long as it was possible to obtain them without difficulty in other countries. The matter was one in which international co-operation was essential, and the whole question was engaging the attention of the League of Nations, which had been entrusted by the Treaties of Peace with the general suspension of the traffic in opium and other dangerous drugs.

THE EVOLUTION OF CHEMICAL TERMINOLOGY.—I. COAGULATION.

By James F. Couch.

(Reprinted from the "American Journal of Pharmacy," February, 1922).

In attempting to define with exactness many of the terms in common use at the present time it is often found that there is considerable latitude of meaning covered by the word or phrase. In many cases the limits set about the proper application of a term are vague and may permit its usage in contradictory senses. Such indefiniteness, foreign to the modern scientific spirit, leads often to indiscriminate use of the term and clutters up the literature with much that is sloppy and too much that is not only misleading but positively erroneous. Unfortunately a great deal of this vagueness cannot be remedied as yet, for it proceeds from an insufficient knowledge of the phenomena with which the term is associated or results from the applying of the term to a broad field which contains within itself confusing and contradictory elements.

In other cases it happens that a term still in common use was applied generations ago to some type of phenomena which were imperfectly understood. With this as a foundation newly discovered facts were classified by more or less empirical methods according to analogy until the term is now made to represent things which in principle are widely different. Again, because of a lack of knowledge of the mechanism of natural processes, two facts which depend essentially on the same fundamental generality have been classified under different names because of some superficial difference in nature.

Another and a fruitful cause of confusion has been the use of specific terms in literature where the exigencies of rhetoric, of the avoidance of repetition, and the difficulties of conveying ideas, not to mention the foot-rule of versification, outweigh considerations of narrow exactitude in the choice of words. We read, for instance, that a large population was coagulated in London; we might, with equal propriety, refer to-day to the "gelated traffic" at our busy street crossings.

It is possible, however, to remedy a large part of the existing indefiniteness in the use of chemical terms; indeed, it is a simple matter. It requires only an agreement among those who employ the terms to limit certain expressions to certain specific meanings. With this very desirable end in view I purpose to consider in this, and in other communications which are in course of preparation, a number of loosely defined terms, to discuss the manner in which they are now used, to present any objections to this usage, and finally to propose whatever action appears to me best to eliminate the undesirable features.

What is coagulation? In referring to such authorities as the writers of text

books, particularly those that deal with physiological and colloid chemistry, we find that while frequent mention of the process of coagulation is made, and while it is *often exhaustively discussed*, the authors studiously avoid defining the term. One must dissect and analyze the whole matter presented by the author before his idea of the process may be determined. We turn, then, to the standard dictionaries of our language.

Webster's presents this definition: "Coagulate . . . To exect the coagulation of; curdle; clot; congeal; . . ."

James A. H. Murray defines "coagulate" thus: "1. To convert (certain fluids, as blood, milk, albumen, etc.), into a soft solid mass, as by chemical action, heat, exposure to air, etc; to curdle, clot, congeal. 2. To form (andthing plastic) into a solidified cake or mass; to form as a mass."

Funk and Wagnall's says: "Coagulate . . . To change (a liquid, as blood or milk) into a clot or a jelly, as by heat, by chemical action, or by a ferment: curdle; congeal."

The Century defines "coagulate" as follows: "*To curdle; congeal; clot; change* from a fluid into a curd like or thickened mass . . ."

Gould defines "coagulation" as "The formation of a coagulum or clot," and D r land as "1. The process of changing into a clot or of being changed into a clot. 2. A clot."

Wo. Ostwald offers this: "Unter Koagulationsvorgängen disperser, im speziellen Systeme *verstehen wir weitgehende* Veringerungen des Dispersitätsgrades der dispersen Phase, verbunden mit einem Aufgeben der Homogenität der räumlichen Verteilung."

The generally accepted idea of the term coagulation, then, is this: It is a process which results in the separation from a liquid system of a non-rigid solid mass or the confersion of a liquid into such a mass. This definition is faulty in that it is too inclusive; it must be modified to distinguish between coagulation and such processes as flocculation, gelation, precipitation, congellation. *

In the first place coagulation is a colloidal phenomenon. Albumen solutions, blood, milk, the latex of Ficus elastica, are all colloidal systems. By limiting coagulation to colloids we remove from consideration many similar phenomena which may, under appropriate conditions, occur in true solutions. The precipitation of aluminium hydroxide by ammonia may give rise to a semi-solid mass which superficially resembles a coagulum. A characteristic of coagulation which readily distinguishes it fro mthe process of gelation is that it involves a separation of the disperse from the continuous phase of the colloidal solution: in gelation there is no such complete and sharp separation, although it is true that the gel may lose its sorbed solvent by evaporation, in the course of time.

When we consider the question of the reversibility of coagulation processes, however, we discover no general agreement. While the common instances of coagulation *(in albumen solutions, blood-clotting, etc.)* are clearly irreversible, there is a large number of instances which are, by some authors, included in the general class of coagulations and which are known to be reversible. Bechhold considers coagulation as irreversible, but prefers to use the term "flocculation" for most colloidal separations. Analysis of his discussion of these phenomena leads to the following conclusion: *Flocculation is an electrical phenomenon*; *it is* irreversible; it consists in the precipitation of hydrophobe colloids by electrolytes. The system, therefore, cannot be flocculated unless it contains an hydrophobe colloid. He distinguishes reversible separations of dispersed phases and their continuous phases by the term "salting out." Bancroft, on the contrary, uses the term coagulation in the broader sense; e.g., he says (p. 221), "When albumin is precipitated by sodium chloride, the coagulation is ordinarily reversible. When it is precipitated by the salt of a heavy metal, the coagulation is irreversible." Consequently there is no agreement as to the reversibility of coagulation; each author determines this question be the extensiveness of his application of the term.

"Colloids in Biology and Medicine". Trans. J. G. M. Bullowa, 1919, p. 82.

"Applied Colloid Chemistry," 1921, p. 212, et seq.

Without attempting to analyse the whole mass of accumulated data t may be said that there are three general methods by which the separation of the phases in a colloidal system may be effected: 1. By alteration of the chemical nature of the disperse phase; 2, by altering the physical struc-

ture of the disperse phase; and 3, by altering the electrical equilibrium of the syste mof of the disperse phase. These are three very distinct processes and depend upon widely different mechanisms. Almost the only similarity is to be found in the end result and even here great differences occur. We know that in the heat-coagulation of albumins there is definite chemical alteration of the molecule; in the clotting process of blood a new substance, fibrin, which is not a factor of the initial system appears, formed from one of the constituents of the normal blood. Neither of these processes is reversible. In the curdling of milk, however, which is the third common instance o fcoagulation, the case is different. In the souring of milk or following the addition of rennin, the casein separates from the liquid mixture. Note that the curdling which follows souring—or the increase of hydrogen in concentration—is a true precipitation of salicyclic aci from an aqueous solution of sodium salicylate upon the addition of a stronger acid. It is not true coagulation. The action of rennin, on the contrary, produces curdling by altering the casein, and the process is not reversible. Consequently, in all three cases of coagulation which are common phenomena and from which our ideas of coagulation are primarily drawn, we have instances of irreversible changes.

Coagulation may be readily distinguished from congelation, as the latter term includes any solidification without regard to its nature or mechanism by which it is produced. The "setting" of wet plaster of Paris or of concrete mixtures are congelations. In the term precipitate we have a general name which includes all instances in which a solid or semi-solid substance, either in an integral mass or in a finely divided state, separates from a liquid. Coagulation is therefore a special case of precipitation. Flocculation may be considered a process in which the degree of dispersity of a colloid in suspension is diminished although this term itself is not narrowly defined and has been used in different senses.

Enough evidence has now been presented, I think, to show the necessity for the adoption of a convention in order to define these terms satisfactorily. We are forced arbitrarily to exclude certain ideas now associated with the terms and to restrict the assigned meanings to limits which will sharply distinguish the different terms. It is therefore recommended that coagulation be defined:

> An irreversible process of colloid chemistry; it consists of the complete or partial separation of the disperse from the continuous phase as the result of the chemical alteration of the system. The altered disperse phase is precipitated as a non-rigid, insoluble, solid mass.

and that flocculation be considered:

> A process of colloid chemistry in which the complete or partial separation of the phases is effected through an alteration of the physical condition of the disperse phase, either by a diminishing of its degree of dispersion or by a modifying of the electrical equilibrium of the system.

The analysis suggests the usefulness of two new terms; collyte, a name for any disperse phase, and collysis, a general term to indicate any separation of the two (or more) phases in a colloidal solution.

New International Dictionary of the English Language, 1919, p. 424.

In some dictionaries the definition is given under the word "coagulation," in others it is given under "coagulate," and the derivative terms are referred to the form defined. I shall here make no distinction in quoting the lexicographers.

A New English Dictionary on Historical Principles, 1898, Vol. 2, p. 548.

New Standard Dictionary of the English Language, 1913, p. 508.

The Century Dictionary and Cyclopedia, Vol. 2, p. 1067, 1911.

An Illustrated Dictionary of Medicine, Biology and Allied Sciences, p. 305.

The American Illustrated Medical Dictionary, 1916, p. 230.

Grundriss der Kolloidchemie, 1910, p. 446. This definition may be freely translated: "By the process of coagulation of substances dispersed in colloidal systems we understand a far-reaching diminution of the degree of dispersity of the disperse phase accompanied by a giving up of the homogeneity of spatial distribution."

BOOKS RECEIVED.

The Vitamins, by Professor H. C. SHERMAN & S. L. SMITH. Pages: III. + 273. The Chemical Catalog Company, 1, Madison Avenue, New York, 1922. Price $4.

Zirconium and its Compounds, by FRANCIS P. VENABLE. Pages: X. + 173. The Chemical Catalog Co. Inc., 1, Madison Avenue, New York, U.S.A., 1922.

Inorganic Chemistry, by T. MARTIN LOWRY, C.B.E., M.A., D.Sc., F.R.S., Professor of Physical Chemistry in the University of Cambridge. Pages: X. + 943. Messrs. McMillan & Co., Ltd., St. Martin's Street, W.C., 1922. Price 28/- net.

Power Alcohol: its production and utilisation, by G. W. MONIER-WILLIAMS, G.B.E., M.C., M.A. Pages: XII. + 323. Messrs. Henry Frowde and Hodder & Stroughton, The Lancet Building, 1 & 2, Bedford Street, Strand, W.C.2. Price 21/-

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A CONCISE HISTORY OF CHEMISTRY.—By T. P. Hilditch, D.Sc. (Lond.), F.I.C. Pp. xii. plus 276. London: Methuen & Co., Ltd., 1922. Price 6/-.

The author has briefly and succinctly outlined the historical development of Chemistry. Introductory and early chapters deal with the general evolution of the science from the earliest times until distinct divisions appeared. The method has then been to treat each branch separately. Thus the history of Organic Chemistry is considered quite apart from the development of Inorganic Chemistry, and the same applies to Plant and Animal Chemistry and to the development of Physical Chemistry.

The chapters on Organic Chemical development have been described particularly well. Theories which have stimulated investigations or which are believed to assist in arriving at the ultimate truth are briefly but carefully considered.

The progress of experimental method is given too concisely. The short final chapter of the book not only covers the developments and improvements in apparatus and methods, but also includes the only references to chemical analysis and the determination of Atomic Weights. These important aspects of the Science thus receive inadequate treatment.

In the next edition the author could also advantageously alter his spelling of Mendeléeff's name.

There are two useful appendices. One is biographical, and catalogues the great achievements of important personalities. The other is a chronological summary of events of outstanding importance.

All who study chemistry should be acquainted with its development. This book, now in its second edition, therefore meets a real need, and should be widely read by all students. J. G. D.

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTRY.—By J. W. Mellor, D.Sc. Vol. ii., pp. VIII. plus 894. London: Longmans, Green & Co., 1922. Price £3 3s.

In this volume the Author has attempted a compilation of all the compounds of the Halogen elements and of the Alkali metals known in Inorganic Chemistry.

He describes their preparation and properties, and wherever possible discusses them in the light of Physical Chemistry.

The collection and arrangement of the material incorporated in this volume must have involved much time, energy and patience. This applies particularly to the copious references to original papers quoted at the end of each paragraph. An idea of the extent of these will be perhaps realised when we state that at the end of the section dealing with the properties of the Alkali Chlorides, no less than six pages are devoted to references on this subject alone; each page contains about a hundred references. We should mention that those we have turned up have been verified.

The test appears to be an amplification of the Author's "Modern Inorganic Chemistry."

The Author might have figured a better apparatus for the preparation of Chlorine than that shown on page 26. Also in the pages on specific gravity and concentration of solutions there is no mention of Mendeléeff's extensive investigatins on this subject.

The value of such a treatise as this is considerable, particularly since, in the past, reliance has largely been placed in Continental compilations. But, since there is no reference to atomic weight determinations, this volume does not quite cover the same ground as, say, Abegg's *Handbuch der Anorganische Chemie*.

The volume will undoubtedly find a place in all Chemical Libraries worthy of their name. J. G. D.

THE INSTITUTION OF ELECTRICAL ENGINEERS

ABSTRACT OF PAPER READ BY MR R. BORLASE MATTHEWS BEFORE, ON THURSDAY, 30 MARCH, 1922, AT 6 P.M.

Ancient Craft and Modern Knowledge.

Relatively to the great productive enterprises of which we hear so much, Agriculture may be called the Silent Industry, in spite of its importance and the rapidity with which variations in its fortunes react upon everyone's pocket, we hear but little of the farmer and his work, yet an engineer, who has gone back to the land with the analytical faculty of his profession has been telling the I.E.E. that the cultivation of the soil and the animals useful to man is still the greatest of human activities.

In England and Wales alone, states Mr. Borlase Matthews, there are 418,000 farms and small holdings, five-sixths of these are of less than 150 acres in extent.

The problem of increasing the yield of all these undertakings is of the utmost importance to the welfare and safety of the country. According to the experience of this expert is it possible even in our own climate, to raise much more food, reduce waste and failure and stabilise the conditions of the Agriculturist by the use of electricity on the farm.

Great progress in this direction has been made in America and Canada, and upon the Continent, whilst in our own country there are already some notable developments, as in the district of Hereford and certain parts of Wales.

The farm, and particularly the small farm, is not an ideal situation for machinery needing skilled attention; it is usually also impossible to supply it with gas, and costly to provide coal or heavy fuel. Electricity, which can at once be used to give light, heat, or drive machines, is obviously the simple and flexible form of power service needed on the land being so easily conveyed by overhead wires, without disturbance of the surface, and free to leave the line of the roads for any point where its services are needed.

Mr. Borlase Matthews has recently placed a record of his experience at the disposal of farmers in this country and on certain parts of the Continent, and has now brought the whole subject to the notice of the Institution of Electrical Engineers, to a great extent depend for the general in- upon the energies of which body one must troduction of an Electric Power supply into rural areas.

The speaker has put forward some most interesting information upon the cost of using Electricity for all general operations around the farm buildings, the saving to be effected by employing electric light in cow sheds, the improvement in cleanliness, reduction in waste of milk, cattle food, and other materials by removing the dark and difficult conditions which exist during a large portion of the year in these buildings.

He shows also how readily an electric motor can be applied to driving different machines, for chopping cattle food, operating churns, milk separators, etc. These motors are entirely covered in from dirt and moisture, need no skilled attention, and can be moved about from place to place according to the work in hand, season of the year, etc.

More extensive applications of this form of power are applied to the ploughing of the land, whilst in other directions we find, as so often happens with the employment of electricity, that the incidental savings and economies resulting from it far outweigh any question of cost—for instance, it has already become the practice to dry hay artificially by means of electrically-driven fans —this gives the farmer much greater control over his crops, and makes him more independent of the weather.

In other districts there are records of the use of electric heating for the prevention of frost amongst stores of roots and vegetables, whilst already it is employed extensively for the drying of fruits in bottling factories and similar undertakings.

It will probably be news to many people to hear that the milking of cows by machinery, and machinery operated electrically, is coming into very general use, many farms employ now this method.

It is stated that in New Zealand over 9,000 farms are fitted with this valuable apparatus, which requires very little power, reduces the number of persons in charge, and goes a long way to provide the necessary cleanliness in handling milk.

(*To be Continued.*)

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

7370—Consortium fur Elektrochemische Industrie Ges. Manufacture of enhydrous chlorides March 13.

7335—Gardner, J. A.—Production of artificial dyes. March 15.

7878—Helbronner, A.—Manufacture of chromate and bichromates. March 15.

7302—Watson, J. K.—Production of ammonium chloride. March 13.

Specifications Published this Week.

160,151—Soc Franco Belge De Fours A. Coke (Soc. Anon).—Process for the treatment of *gases from gas-producers.*

176,034—British Cellulose and Chemical Manufacturing Co., and Richardson, L. G.—Treatment of *cellulose* acetate products.

176,038—Imray, O. Y.—Manufacture of new therapeutically active acridine derivatives.

155,577—Haus, G. S.—*Manufacture of derivatives* of 3; 3-diamino-4 dioxarsenobenzene.

176,144—Casale, Dr. L., and Leprestre, R.—Apparatus for the catalytic synthesis *of* ammonia.

Abstract Published this Week.

Lead Sulphate; zinc oxide; furnaces.—Patent No. 174,555.—Messrs. H. Mayers & Britons, Ltd., of 17, *Redriffe Road, Plaistow, and The Stowage,* Deptford, both in London, have been granted a Patent for a new treatment of minerals.

The *production of distillates from mineral matters*, such as the prouction of basic lead sulphate or zinc oxide from sulphide ores by feeding the ore on to a bed of fuel and oxidizing the vapour, the product being passed to cooling and filtering chambers, is effected in apparatus in which the draught through the filters and cooling-chambers and the air admitted to the furnace are controlled by means situated at the furnace itself, so that an operator, while watching the flame of the furnace, if necessary, through a spectroscope, can adjust the conditions so as to keep the oxidation constant.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3236.

THE PASTEUR CENTENARY.

STRASBOURG, MAY—OCTOBER, 1923.

In order to commemorate the Centenary of the birth of Pasteur, the University and the town of Strasbourg, with the concurrence of the Pasteur Institute, and the approval of the family of Pasteur, have proposed to erect a statue facing the Strasbourg University where, as a professor, Pasteur commenced his career.

The inauguration ceremonies will take place on May 1st, 1923, under the patronage of M. A. Millerand (President of the Republic), M. le Président A. Loubet, M. R. Poincaré, M. Loredu and M. Alapetite, and will include the unveiling of the statue and the opening of an exhibition of Hygiene and Bacteriology. This Exhibition will be designed to illustrate the advances made in various branches of science as the result of Pasteur's discoveries, and at the same time, a Congress of Hygiene and Bacteriology will be held for the discussion of questions relating to the prevention of disease.

With the object of showing the sympathy of this country with the projects of the French Committee, a British Committee *composed of the following members* has been formed:—

Sir Charles Sherrington, G.B.E., President of the Royal Society (Chairman).

Mr. A. Chaston Chapman, F.R.S., President of the Institute of Chemistry of Great Britain and Ireland (Treasurer).

Mr. H. E. Field, President of the Institute of Brewing.

Prof. Percy F. Frankland, C.B.E., F.R.S., Emeritus Professor of Chemistry, University of Birmingham.

Sir John M'Fadyoan, M.R.C.V.S., LL.D., Principal of the Royal Veterinary College.

Prof. C. J. Martin, C.M.G., F.R.S., Director of the Lister Institute.

Sir W. J. Pope, K.B.E., F.R.S., Professor of Chemistry, University of Cambridge.

Sir James Walker, F.R.S., President of the Chemical Society.

Sir Almroth Wright, K.B.E., F.R.S., Principal of the Institute of Pathology and Research, St. Mary's Hospital.

It is hoped that those who desire to contribute to the Memorial will send their contributions to the General Secretary and Treasurer, Monsieur Th. Héring, 6, rue des Veaux, Strasbourg, or to Mr. A. Chaston Chapman, F.R.S., The Institute of Chemistry, 30, Russell Square, London, W.C.1.

The Commissioner-General, Professor Borrel, is very anxious to be furnished with the names of manufacturers and business firms in this country to whom the Exhibition might be of especial interest. All who can assist are requested to communicate with Professor Borrel, 3, rue Koeberle, Strasbourg.

POLYMERISATION AT THE CRITICAL TEMPERATURE.

By Wm. R. Fielding, M.A., M.Sc., Vict., Senior Science Master at King Edward VII. School, Lytham.

[NOTE.—The data used in this paper have been taken from Landolt-Börnstein's Tables, and the paper is a continuation of "Polymerisation amongst Liquids," *Chem. News*, 1921, Vol. 122, p. 289.]

(*Continued from Last Week*).

The following methyl compounds are arranged in order of p:—

	C.T.	p
$CH_3.CN$	548 ...	1.43
$CH_3.COOH$	594 ...	1.57
$CH_3.OH$	513 ...	1.71
$CH_3.H$	191 ...	1.90
$CH_3.Cl$	416 ...	2.06

Van der Waal's equation takes no cognisance of polymerisation.

$$\text{From} \quad \left(P + \frac{a}{v^2}\right)(v - h) = R.T.$$

$$V_c = 3b.$$

That this is not so is clear from the following examples:—

	v_c	3b
N_2O	0.00436	0.005520
CO_2	0.00438	0.005721

For the values of p that I have obtained

$$v_c \times \sqrt[3]{p} = 3b.$$

appears to be more nearly correct.

	v	p	$v\sqrt[3]{p}$	3b
N_2O (1894)	0.00436	2.28	0.005738	0.005520
CO_2 (1907)	0.00438	2.17	0.00567	0.005721
$(C_2H_5)_2O$ (1908)	0.01292	2.1	0.01655	0.016749
C_6H_6	0.01146 (1908)	2.08	0.01463	0.015450 (1893)
		1.94	0.008892	0.016107 (1910)
C_2H_5OH (1886)	0.00713			0.011307

If $v\sqrt[3]{p} = 3b$,

Then $v = \frac{3b}{\sqrt[3]{p}}$ and $\sqrt[3]{p} = \frac{3b}{v}$

and the critical volume or p can be found.

For example, p for H_2O is

1.34 (if $d_c = 0.429$)

1.75 (if $d_c = 0.329$)

$b \times 10_6 = 1362$ (Holborn u. Bauman, 1910)

$\therefore v = \frac{0.004086}{\sqrt[3]{1.34}}$ or $\frac{0.004086}{\sqrt[3]{1.75}}$

$= 0.003706$ or 0.00339

(c.f. 0.003864, Battelli, 1890).

Or, find p_c for CS_2.

$v_c = 0.009011$

$b \times 10 = 3431$ (Battelli, 1890)

$\therefore p^{\frac{1}{3}} = \frac{3b}{v}$

$\therefore p_c = 1.49$

(c.f.) p = 2.17 for CO_2.

If this relationship has any solid foundation, then Van der Waal's equation will become

$$\left(P + \frac{a}{p^2}\right)\left(v - \frac{b}{\sqrt[3]{p}}\right) = R.T.$$

$$\therefore \frac{T_c \sqrt[3]{p}}{P_c\ b} = \text{a constant}.$$

and from

$$\frac{M\ P_c}{p + d_c + T_c} = \text{a constant},$$

and

$$\frac{T_c \sqrt[3]{p}}{P_c\ b} = \text{a constant},$$

we obtain

$$\frac{M}{p\ d_c} \cdot \frac{\sqrt[3]{\ }}{b} = \text{a constant},$$

i.e., $\frac{M}{d_c\ b\ p^{\frac{2}{3}}}$ = a constant. See Table IX.

TABLE IX.

	d_c	$b \times 10$	p	M	$\frac{M}{d_c\ b\ p^{\frac{2}{3}}}$	Observer.
$(C_2H_5)_2O$	0.26	5887	2.1	74	29410	(Galitze, 1901)
	0.2625	6002	2.1	74	29640	(Young, 1910)
CH_3COOH	0.3506	4767	1.57	60	26.590	(Young, 1910)
CO_2	0.464	1912	2.17	44	29.600	(Amagat, 1892)
SO_2	0.52	2516	2.11	64	29.740	(Cailletet, 1887) (Cardoso, 1910)
C_5H_1	0.23?	5390	2.50	70	30.660	(Vespignani, 1903)
H	0.033	977	1	1	31.010	(Dewar, 1902-4)
$SnCl_4$	0.7419	7332	2.09	261	29360	(Young, 1910)
A	0.509	1348	2.36	39.9	32820	(Ramsey & Travers, 1901) (Crommellin, 1910)
N_2O	0.454	1840	2.28	44	30420	(Viliard, 1894)
$C\ H_6$	0.3045	5369	2.08	78	29270	(Young, 1910)
C_6H_5Br	0.4853	6872	2.05	157	29170	(Young, 1910)
X	0.94	2303	2.60	130.2	31800	(Ramsey & Travers, 1900)
CH_3OH	0.2722	2992				
			1.71	32	27480	(Young, 1910)
C_2H_5OH	0.2755	3753	1.94	46	28610	(Young, 1910)
C_3H_7OH	0.2734	4577	1.945	60	28720	(Young, 1910)

Some of the data used is rather old, but selecting values calculated from the data supplied by the same investigator (Young, 1910), the results appear more consistent.

	Ether	28,640
***	Acetic Acid	26,590
	Stannic Chloride	29,360
	Benzene	29,270
	Brom.-Benzene	29,170
	Methyl Alcohol	27,480
	Ethyl Alcohol	28,610
	Propyl Alcohol	28,720

The average is 28,480, so no result is more than 7% different from the mean.

Slight changes in d_c or b would make the numbers still more alike. So I have tentatively accepted the following equations at the critical temperature:—

$$p_c = \frac{M\ P}{k\ d_c\ T_c} \quad \text{where } k = 10.5$$

$$v_c \sqrt[3]{p} = 3b$$

$$\left(P + \frac{a}{v}\right)\left(\frac{v - 3/b}{\sqrt[3]{p}}\right) = R.T.$$

$$\frac{T_c + p\ + S}{R_t} = 22.15$$

$$\frac{M}{d_c\ b\ p^{\frac{2}{3}}} = \text{a constant}$$

$$p_c\ W\ s = k$$

(where W = average weight of atoms present and k depends on the critical temp. See *Chem. News*, 1921, Vol. 122, p. 292).

*** *In substituting in the formula* $\frac{M}{d_c\ b\ p^{\frac{2}{3}}}$ = a constant, the molecular weight used is that of the unassociated molecule. But in the case of acetic acid, etc., some association takes place even in the gaseous state, so that M for these substances is too small, and hence the value of the constant is too small. Gaseous acetic acid, for instance, has a molecular weight of about $60 + \frac{28,480}{26,590}$ i.e., 64.2, at its C.T., and contains about 7% of double molecules.

THE INTERACTION OF METHYL IODIDE AND POTASSIUM PLUMBITE.

A Comparison of the Behaviour of Alkaline Solutions of the Hydroxides of Tin and Lead.

By J. G. F. Druce, M.Sc., A.I.C.

It has been previously found that methyl iodide reacted with an alkaline solution of stannous hydroxide, producing the alkali salt of methyl-stannonic acid, $CH_3\ SnOOH$ (Druce, *Chemical News*, 1920, cxx., 229; Pope and Peachey, Proc. Roy. Soc., 1903, lxxii., 7; Pfeiffer and Lehnardt, Ber., 1903, xxxvi., 1054).

Since tin and lead are in the same group in Mendeléeff's Periodic Classification of the Elements, it was thought desirable to determine whether a similar organo-metallic acid containing lead could be isolated.

No such compound has, however, been prepared during the course of experiments in which the procedure adopted was the same as in the preparation of the methyl stannonic acid. Alkaline solutions of lead hydroxide were found to react with methyl iodide depositing clusters of crystals of lead iodide.

When carbon dioxide was passed through the filtrate from these crystals, it gave a precipitate containing lead and iodine. No carbon was detected in this prodset.

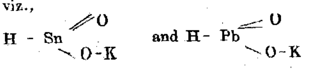
In another experiment it is now shown that methyl alcohol is a product of the interaction of potassium plumbite and methyl iodide. Therefore the reactions which took place were that, firstly, the potassium hydroxide present hydrolysed the methyl iodide into methyl alcohol and potassium iodide; then the latter reacted with the potassium plumbite to produce lead iodide, as indicated by the equations:

(a) $KOH + CH_3I = CH_3OH + KI$

(b) $2KI + K_2PbO_2 + 2H_2O = 4\ KOH + PbI_2$; or

$2KI + KHPbO_2 + H_2O = 3\ KOH + PbI_2$

It will be observed that the second stage of the reaction can be represented in either of two ways according to whether the presence of normal or "acid" plumbite is assumed. The latter would be in accordance with Hantzsch's view (*Zeit. Anorg. Chem.*, 1902, xxx., 289), that when tin and lead hydroxides dissolve in alkalis the hydrogen salts are produced, and have a structure similar to that of the formates, viz.,



In the case of lead hydroxide, Berland Austerweil (*Zeitsch. Elcktrochem.*, 1907, xiii., 165), found that this held for those *solutions in which the strength of the* alkali (sodium hydrate in this case) was below normal. More concentrated solutions were *considered to contain some of the normal* plumbite, Na_2PbO_2.

From quantitative experiments, it appears that more alkali than is required to form the normal plumbite must be added in *all* cases, to dissolve freshly precipitated lead hydroxide (see also Rubenbauer, *Zeit. Anorg. Chem.*, 1902, xxx., 331).

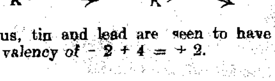
When such solutions were *boiled they remained clear. In this respect lead* behaved differently from tin.

When *potassium hydroxide was added* to stannous chloride so that the precipitate first produced had re-dissolved, a solution was *obtained*, which, *on boiling*, gave a fine grey precipitate of metallic tin. The filtrate from this precipitate contained potassium stannate, and the course of this reaction may be indicated thus:—

$$(2\ H.Sn\ OOK = H_2O + K_2\ SnO_3 + Sn)$$

It will be observed that in the structural formulæ assigned to potassium hydrogen stannite and potassium hydrogen plumbite by Hantzsch (*loc. cit.*), the tin and lead appear quadrivalent, whereas these salts are obtained *from divalent compounds* of the metals under circumstances which do not admit of any oxidation.

This *anomaly in the representation* of these compounds is removed if the recent views of Brauner (*Analysa Qualitativni*, 1919, Prague, p. 164) on valency are accepted. In such compounds, Brauner considers that the central metallic atom possesses the property of simultaneously increasing its positive valency and its negative valency, each by the same number of units. In the electronic conception of valency this corresponds with the gaining and simultaneous yielding of valency electrons. The total valency remains unchanged, and, denoting the direction in which the electrons are attracted, potassium *hydrogen* stannite and plumbite can be denoted:—



Thus, tin and lead are seen to have total valency of $-2 + 4 = +2$.

EXPERIMENTAL.

Lead nitrate (8 grms.) was dissolved in 50 cc. of hot water and precipitated with excess of ammonium hydrate. The precipitate was filtered and washed with hot water until the filtrate was almost neutral. *It* was dissolved by warming with 100 cc. of potassium hydroxide solution containing 1 2grms. When this solution was cold, 3.6 *grms. of methyl iodide* were added, together with 100 cc. of alcohol.

After 24 hours, clusters of pale yellow crystals appeared. More were deposited by the following day. At the end of a week the crystals were isolated and washed with *cold* water. They dissolved somewhat in hot water, but separated again on cooling. On heating alone they melted at about 370° *C. and gave off a small amount* of iodine vapour. Other experiments were carried out, and all indicated that the substance was *lead iodide*.

On analysis 0.3503 grm. gave 0.2241 grm. $PbSO_4$; Pb = 43.7 per cent.; PbI_2 requires Pb = 44.95 per cent. A trace of potassium sulphate was also obtained, but the potassium present in the crystals was *less* than one per cent.

Carbon dioxide was passed into the filtrate from the lead iodide crystals, and *precipitated an almost white product. This* was filtered and washed with cold water. It was slightly soluble in hot water, and on *examination was found to contain lead and* iodine. Thus the solution in hot water gave a precipitate with silver nitrate, which did not dissolve in hot ammonium hydrate solution. Similarly potassium chromate gave a yellow precipitate with the substance in hot water. When the solid was heated with copper oxide, no carbon dioxide was evolved, since the small amount of gas produced gave no precipitate when passed through lime water. A similar result was obtained when the crystals which first separated were heated with copper oxide.

In a second experiment the same quantities of alkali, lead hydroxide and methyl iodide were used, but the alcohol was *omitted*.

Lead iodide crystals appeared as before, and the methyl iodide gradually disappeared. The filtrate was distilled, and the first fraction of the distillate was inflammable, burning with a very pale flame which was tinged a bluish colour. The

distillate gave no precipitate with silver nitrate, even after several days; hence, no methyl iodide was present. The rest was again slowly distilled with potassium dichromate and concentrated sulphuric acid. An ammoniacal solution of silver oxide was added to this distillate (which had the odour of formaldehyde), and on warming the mixture a silver mirror appeared. These results were considered to be adequate proof of the presence of methyl alcohol in the products of the interaction of potassium plumbite and methyl iodide.

Another experiment was carried out in which the lead hydroxide precipitated from 8 grms. of the nitrate was dissolved in a solution containing 12 grms. of potassium hydrate and a solution of 4.1 grms. of potassium iodide was added. Again, after standing overnight, granular crystal groups separated as in previous experiments. This was considered to indicate that the lead iodide deposited through the interaction of methyl iodide and potassium plumbite were produced through the intermediate formation of potassium iodide.

A potassium hydroxide solution of stannous hydroxide was made as described in the preparation of methyl stannonic acid (*Chemical News*, 1920, cxx., 229). It was gently boiled for ten minutes.

The grey precipitate which formed was allowed to settle, and the clear liquid was decanted. When this was acidified with hydrochloric acid so that the precipitate (of metastannic acid) first produced had redissolved, hydrogen sulphide was passed through the solution and gave a yellow precipitate of stannic sulphide. Thus the decanted liquid contained potassium stannate. The grey precipitate was washed by decantation and finally filtered, washed and dissolved in hot strong hydrochloric acid with evolution of hydrogen. The solution obtained answered the tests for stannous chloride.

CHEMICAL IMPORTS TO MEXICO.

Replying to Mr. Alfred Short Sir Philip Lloyd-Graeme, Secretary to the Overseas Trade Dept., said that there was a good demand in Mexico for certain British manufactured goods, including heavy chemicals. Local production practically satisfied the demand for some of them; but British trade with Mexico had been maintained.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, APRIL 6, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

F. E. SMITH, F.R.S. On an Electromagnetic Method for the Measurement of the Horizontal Intensity of the Earth's Magnetic Field.

The instrument is the outcome of a suggestion made by Sir Arthur Schuster. It is designed to measure "H" within a few minutes, and with a probable error of only a few parts in 100,000. For constructional purposes as well as to ensure a uniform magnetic field at and near the centre of the system, a Helmholtz-Gaugain arrangement of coils was adopted.

The coils consist of two interwoven helices on each side of the centre; they are of bare copper wire, and are wound in spiral grooves cut in a marble cylinder. Each coil is of 30 cm. radius, of six turns, and of $1\frac{2}{3}$ mm. pitch. The cylinder is mounted on a non-magnetic base, and can be rotated about a vertical axis. The magnet at the centre is 1 cm. long and about 6 sq. mm. in cross-section; it is supported on a V of aluminium foil by a fine quartz fibre, to which is attached also a reflecting mirror and a damping vane. The magnet is easily removed from its support, and a copper wire of equal weight and of nearly the same dimensions can be substituted. This enables most of the torsion of the fibre to be removed.

In practice, the axial magietic field due to the current in the coils is made slightly greater than "H" and its component in the magnetic meridian opposes H. By adjustment of the angle α between axis of cylinder and direction of magnetic north, the indicator magnet is caused to set at right angles to the meridian. When torsion on the fibre is eliminated,

$$H = F\,i\cos\alpha,$$

where F is constant of coil system and i is current. The current was measured by the N.P.L. current balance.

A measurement of H, with calculation complete, occupies less than 4 minutes. The probable error of a measurement, in-

cluding the error due to uncertainty of the value of the current, is about + 4 parts in 100,000.

G. I. TAYLOR, F.R.S. Stability of a Viscous Liquid contained between Two Rotating Cylinders.

1. *It is shown that steady motion* of viscous liquid contained between two concentric rotating cylinders is unstable for *symmetrical disturbances, provided velocity* of system is greater than a certain value, and ratio of angular velocities of *cylinders less than reciprocal of square of* ratio of their radii, or is negative. When the ratio of speeds is greater than this *value, instability of the type for lower* values of the ratio cannot arise.

2. The type of instability which appears *is periodic along length of cylinders*, and consists of vortices enclosed in partitions rectangular in section. These vortices rotate alternately in opposite directions as though geared together.

3. When the cylinders rotate in the same direction each vortex extends across the space between the cylinders. In this case the length parallel to axis of cylinder occupied by each vortex is equal to thickness of layer of fluid between them.

4. When the outer cylinder rotates in the opposite direction to the inner, and with an angular velocity $1\frac{1}{2}$ times as great, the disturbed motion consists of two systems of vortices all rotating as though geared together. The outer system, however, is very much *less vigorous than the* inner.

5. In this case, the space parallel to *the axis occupied by each vortex decreases* as the radial thickness of the space occupied by the inner vortices decreases, in *such a way that the section of the* partition filled by each vortex of the inner system remains approximately square.

6. *Criteria for stability have been* obtained in approximate form suitable for numerical computation in the case when *the cylinders rotate in same direction, and* in one particular case when the rotations are opposite.

Prof. T. H. HAVELOCK, F.R.S. Dispersion Formulæ and the Polarisation of Scattered Light; with Application to Hydrogen.

Simple types of dispersion formulæ are considered when the medium consists of anisotropic molecules distributed at random, *and the polarisation of scattered light* is brought into relation with these formulæ. In particular, if the molecules have an axis *of symmetry, the dispersion formula may* be written as

$n - 1 = \frac{1}{3}C\,[(p_1 - p) + 2\,(p_2 - p)]$

$= \frac{1}{3}\,[(n_1 - 1) + 2\,(n_2 - 1)]$.

The corresponding ratio of the intensities of the two polarised components of light *scattered at right angles, when the primary* light is unpolarised, is

$6\,(n_1 - n_2) / [45\,(n - 1) + 7\,(n_1 - n_2)]$.

The case of hydrogen is examined numerically. Two dispersion formulæ of the required type are obtained; further, the ratio of the intensities agrees substantially with Lord Rayleigh's experimental value. Other dispersion formulæ for hydrogen are also examined from this point of view.

G. R. GOLDSBROUGH, D.Sc. The Cause of Encke's Division in Saturn's Ring. Communicated by Prof. T. H. Havelock, F.R.S.

This paper is the continuation of a former ("Phil. Trans.," A, Vol. 222, p. 101), and examines the effect of the inclination of the satellite orbit upon a ring of particles surrounding the planet Saturn.

It is shown that such a satellite will, from its inclined path alone produce one new division in the Ring System.

If the satellite be Mimas, a narrow division closely corresponding to Encke's Division is produced. Similarly, Enceladus should produce a division in Ring B, but reasons are adduced showing that it should be almost unobservable.

C. SPEARMAN. Correlation between Arrays in a Table of Correlations. Communicated by Prof. L. N. G. Filon, F.R.S.

The aim is to show what the correlations between arrays can reveal as to the inward structure of the variables concerned. A method is demonstrated whereby the said correlations between arrays may be expressed as functions of the independent variable elements entering into the main variables. In this way, proof is given that, when only one and always the same element is common to any different variables, *then the correlation between every two* parallel arrays amounts to plus or minus unity. Conversely, when every two parallel *arrays have all their corresponding* correlations in any constant proportion, then any different variables can only possess one and always the *same element in common.*

The correlational coefficients considered are throughout of the ordinary kind, *derived from product moments.* The proofs are quite general, and, in particular, do not assume any "normal" frequency distribu-

tions. The application has chiefly in view certain fundamental theories of psychology.

Dr. W. L. BALLS. Apparatus for *Determining the Standard Deviation Mechanically*. Communicated by Prof. J. N. Yule, F.R.S.

This simple calculating apparatus is related to the "Harp" Harmonic Analyser *formerly described* ("*Proceedings*," A, Vol. 99, 1921,, similarly utilising separately loaded strings to deflect a yoke upon which they all converge.

The design of the yoke has been so modified as to make the readings quantitative, while each string is loaded in proportion to the square of its deviation from the zero position. A template, representing the frequency curve under examination, is inserted behind the loaded strings, whereupon the movement of an optical lever at once gives the "sum of the squares of the deviations." This reading is then transferred to a monograph to complete the calculation.

The values obtained for standard deviations are correct to within 5 per cent.; they can be obtained much more rapidly than by calculation, and without occupying the time of a skilled computer.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society, held at the Imperial College of Science and Technology on Thursday, 6th April, Sir *Frank discussed*:—

(1) "Diffraction Halos in Normal and Glaucomatous Eyes," by H. H. Emsley and E. F. Fincham.

Every normal eye, under appropriate *conditions*, sees *diffraction* rings or halos encircling bright sources of light. Halos of a similar nature are seen by eyes in certain abnormal pathological conditions, particularly in the case of eyes suffering from *glaucoma*.

The practical importance, from the oculist's point of view, of a more exact knowledge of the peculiarities of these halos rests upon the desirability of being able to differentiate with certainty between the halos seen by an eye in normal condition and those seen by an eye suffering from glaucoma. Results of observations are given and tests are specified by means of which the different phenomena in the two cases may be identified.

(2) "The Effect of Changes on Surface Curvature at the Focus of an Astronomical Object Glass," by E. Wilfred Taylor.

The correct balancing of the components of a large object glass is necessarily a lengthy and difficult process, and the effect, at the focus, of a similar alteration of curvature at each of the four surfaces, is different. If the effect of an alteration at each of the surfaces is known, the one most suitable may be chosen, having regard to the amount and nature of the aberration it is necessary to overcome.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ABSTRACT OF PAPER READ BY MR R. BORLASE MATTHEWS BEFORE, ON THURSDAY, 30 MARCH, 1922, AT 6 P.M.

Ancient Craft and Modern Knowledge.

(*Continued from Last Week*).

So far the application of electricity on the farm is largely a matter of employing methods which have already been tried and found successful in manufacturing industries—a safe and adaptable form of light easily installed in any building, old or new, a flexible means of driving machines independent of the use of fuel, the production of smoke, heat and fire risk, naturally commends itself to the farmer who has once seen it in operation and can get the necessary supply of power, particularly so as experience shows that the actual amount of power required across the year is a very small matter on the farm, but in addition to this it is obvious that we may expect remarkable further developments as electrical engineers give more and more attention to these problems.

Already the use of electric heat has been successfully employed for incubation.

Electric light has been shown capable of increasing the yield of eggs, or at least increasing their yield during that period of the year when they are of the highest market value.

Other applications of electric power full of promise relate to the sterilisation of milk. The treatment of green fodder preserved for winter use by the method known as Ensilage, and last, but not least, there is a wide, and as yet but imperfectly explored, field electro-culture.

It has been known for a long time that plant growth could be stimulated by the discharge of electricity at very high tension in its neighbourhood, although the precise reason for this is yet comparatively obscure.

Recent experiments on a practical scale have, however, demonstrated that an extremely small amount of electrical power converted in suitable apparatus to a very high tension and discharged from overhead wires strung across the fields has a remarkable effect upon most forms of vegetable life, increasing their yield, and in many cases advancing the period of harvest.

Although it is at least possible that this effect may be rather in the nature of a stimulant than a food, and due to some effect upon the plant which enables it to pick up nutriment from suitable land more successfully tha nit could do unaided, yet there is already sufficient evidence to justify careful and continued research in this direction.

CHEMICAL NOTICES FROM FOREIGN SOURCES

New Distinctive Characteristics of the Three Propanol 2-Camphocarbonolides Fusing Respectively at 141°, 117°, 118°, and 89°-90°.—*A. Haller and Mme. Ramart-Lucas.*—The two propanol -2-camphocarbonolides, which fuse respectively at 141° and 117°-118°, are derivatives of the isomeric allylcamphocarbonates, and the former possesses the configuration of a cis-trans molecule, and the latter that of a cis-cis compound. This difference of configuration results from the fact that the olide of melting point 141° yields a propanolcamphocarbonic acid which can be isolated as such, while the isomer fusing at 117-118° does not give a stable acid alcohol, but lactonises as soon as it is set free from its sodium salt. This difference of behaviour furnishes a means of separating the two isomers. The third isomer of melting point 89-90°, when subjected to the same treatment, gives a β propanolcamphocarbonic acid which differs from the α compound both as regards its temperature of decomposition (115°-120°), and as regards the solid camphopropanol (*m. pt.* 100-101°) to which it gives rise. The phenyl urethane of the last alcohol differs from that of the isomeric alcohol in the nature of its crystals and in its rotatory power.—(*Comptes Rendus*, CLXXIV., 1922, No. 12.)

Preparation of Ethyl Carbamate.—*L. Guerci.*—Having occasion to prepare considerable quantities of ethyl carbamate, the author found that the usual method of making nitrate of urea react with absolute ethyl alcohol in a closed tube at 130° was inconvenient, although the yield was good, and he has discovered a cheaper and better method. It depends upon the action of nitrate of urea upon absolute alcohol in presence of sodium nitrate. The absolute alcohol and nitrate of urea are heated together (3 kg. of the former to 1 kg. of the latter) on a water bath to a temperature of 60-70°, and the sodium nitrate is added gradually in small portions of about 25 gr. so that about 561 gr. are added altogether in the course of two hours. The reaction is allowed to proceed on the water bath for another hour, and then the absolute alcohol is rapidly distilled off under reduced pressure. Thus an oily mass is obtained, which solidifies on cooling. It is extracted with benzene, and the solvent is finally distilled off; the urethane then crystallises in beautiful needles which melt at 47-50°. The yield is about 80 per cent. of the theoretical yield.—(*Giornale di Chimica Industriale ed applicata*, IV., 1922, No. 2.)

Action of Light upon Uranic Salts.—*J. Aloy and E. Rodier.*—To make a systematic study of the action of light upon uranous salts, the authors have used aqueous (or sometimes alcoholic) solutions containing from 1 to 5 per cent. of uranyl salts. The solutions also contained some substance which could be oxidised (aldehyde, ether, alcohol, glucose, etc.), and a variable quantity of the acid corresponding to the salt used. If R denotes a monovalent acid radical, and UO_2R_2 a salt of uranyl, the transformation of this salt into the normal uranous salt under the influence of light and in presence of an oxidisable substance can be represented by the equation

$UO_2R_2 + 2RH + A = UR_4 + H_2O + A\ O.$ The substance represented by A may be an alcohol which is converted into aldehyde or acid. The equation shows the need for the presence of a certain quantity of free acid in the solution. The reaction can be followed qualitatively by the examination of the very characteristic absorption spectrum of uranous solutions and quantitatively by determinations with potassium permanganate. Usually a green solution of the uranous salt is obtained, or in exceptional cases the salt is precipitated. By this method the authors have obtained UF_4, UCl_4, and hydrated uranous sulphate $U(SO_4)_2 + 4H_2O$, but have not succeeded in isolating uranous nitrate. When the quantity of free acid is insufficient the uranous salt formed is decomposed, an insoluble basic salt being formed. Thus a light green precipitate of a basic uranous chloride can be obtained, but no definite crystalline compound has been isolated, and the composition of the precipitate seems to depend upon the conditions of the experiment. The dark brown colourations with or without black precipitates, which have been mentioned by several authors, are the result of a more advanced decomposition of uranous salts under the combined influence of light and solar heat. All the uranous salts obtained suffer this decomposition provided that the liquid is only slightly acid and the action of light is long enough. A black precipitate can also be obtained without the intervention of light if the slightly acid solutions of uranous salts are heated with a sufficient quantity of water.—(*Bull. Soc. Chim.* XXXI.-XXXII., 1922, No. 3.)

GENERAL NOTES

CHEMICAL FACTORY CONDITIONS.

Mr. Shortt, Home Secretary, replying in the House of Commons to a question by Mr. Wignall, said that the conditions in the chemical industries had been the subject of special investigation, and draft Regulations under Section 79 of the Factory and Workshop Act, 1901, had been under discussion with the industries for some time past. These Regulations, which it was hoped to bring into force very shortly, would require the provision of protective clothing and other welfare arrangements for persons employed in a number of processes liable to cause special danger to health. It was originally hoped to apply these arrangements more widely, but in view of the expense entailed, and other circumstances, it had been necessary for the present to limit them to the specially dangerous processes.

BRAZILIAN DYE TRADE.

Lieut.-Col. Sir John Norton-Griffiths asked the President of the Board of Trade whether steps would be taken with his active support and that of his department to counteract the impression now being made in the Brazilian aniline dye trade by officially supported corporations of German traders; and whether he would consider the the desirability of investigating the means by which such steps might conveniently be taken, and of reporting upon the same, for the benefit of British traders to whom the Brazilian dye trade was of so much importance, having regard to its prosperity in 1919 and 1920.

Cr. Baldwin replied: I shall be glad to consider any information and suggestions on this matter which my hon. and gallant friend may care to send to me, and to draw the attention of British dye manufacturers to the importance of the Brazilian market. I would point out, however, that the present depreciated state of the German exchange gives the German manufacturers a very substantial (though it may be only temporary) advantage in respect of export trade.

IMPORTED ARSENIC.

Sir Edardd Nicholl asked the President of the Board of Trade if he had received any complaint that arsenious acid was being imported into this country under the name of arsenic or powdered white arsenic, which corresponded with tbe definition of the arsenious acid which was dutiable according to the list of the Board of Trade drawn up under the provisions of the Safeguarding of Industries Act (List H), and that such imports were not bearing the duty imposed by the Act.

Mr. Baldwin replied: A complaint has been made that arsenious acid which is being imported under the names mentioned by my hon. friend is, in fact, of the grade included in the Board of Trade list, and is

therefore chargeable with duty. I am, however, unable to agree that the heading in question covers ordinary refined white arsenic of the grades generally used in industry.

Sir Edward Nicholl asked in what respect industrial-grade arsenic differed from the dutiable article as included in the Board of Trade list.

Mr. Baldwin said that industrial grade arsenic differed from the dutiable article in that it was produced and refined on a large scale by processes whic hcould not be regarded as fine-chemical processes, but were in the nature of metallurgical processes, whilst the dutiable article was produced by typically fine-chemical processes for use, for instance, as an analytical reagent. The standard of purity required for the reagent was higher than that of the ordinary industrial grades.

DIAMOND CUTTING.

The experiment of Sir B.unard Oppenheimer in establishing a diamond-cutting factory to utilise the labour of disabled soldiers appears to have met with striking success. Beginning on a very small scale in July, 1917, it has now developed into the largest diamond-cutting factory in the world, and the English seaside resort, Brighton, is destined to figure as a prominent centre of the diamond industry, alongside Antwerp and Amsterdam. At the end of 1920, as many as 700 hands were employed here, and provision has been made for increasing the number of workers to 2,000. During the first six months of training the men receive an allowance from the Ministry of Labour, in lieu of their pension, no wages being paid to them by the firm, but free expert instruction being provided for them. At the expiration of the six months' training, the ex-soldier again receives his pension from the Ministry of Pensions, and is given a weekly wage of £2 by the firm. As he becomes more proficient, his remuneration is increased, and by the end of his first year an average cutter earns £3 a week; in the second year this average rises to over £5 a week. If expectations are fulfilled, the British Empire will soon be not only the chief producer of diamonds, but will also have a large share of the profits derived from cutting the stones mined in British dominions.

As an indication of this, it is stated that diamonds valued at £500,000 have not long since been shipped to Antwerp. In addition, orders from the East have reached a value of £300, and exports have been made to Paris and New York. A diamond weighing 600 carats, the largest received up to the middle of November, 1920, was cut into 40 stones of considerable sixe and a number of smaller ones. The industry does not depend solely upon South African diamonds, for rough diamonds to the value of £250,000 have been received from British Guiana and cut at Brighton. The machinery used is manufactured in Sussex County, and thus any needed part can be duplicated and replaced with very little delay. As has been stated, the work at Brighton is done exclusively by disabled soldiers of the world war, instructed in the diamond-cutters' art by expert Belgian workers who sought refuge in England during the German occupation of their native country.

FINE CHEMICALS.

We have received from the Association of British Chemical Manufacturers a list of the British fine chemicals produced by the members of the Association. The list is dated March, 1922, and occupies close upon 40 pages of chemical preparations arranged in alphabetical order, together with a series of index numbers which give the names of the manufacturers producing them.

The list is very encouraging, on account of its completeness and the means of being able to tell in a moment where to procure any of the reagents will be of the greatest value in the laboratory.

In addition to the chemical compounds enumerated, a list of the indicators in common use is given, and also one of dry microscopic stains.

We notice that there are only 38 firms whose names are given as manufacturers, and we hope that in the near future this number will be largely increased.

The proceedings at the monthly council of the Royal Agricultural Society of England, which has just come to hand, show that a large amount of valuable work is being carried out. A short section dealing with the chemical examination of fertilisation and feeding stuffs shows the need for careful examination of products that find their way into the market with glowing advertisements. One case is recorded of material that was sold as a "fertiliser and purified" at £7 per ton, and was found to consist of nothing more than waste lime of inferior quality, worth not more than 50s. per ton. Barley meal was found to con-

tain much sand, &c. These cases are being followed up, and the work will probably be extended in the near future.

LONDON COUNTY COUNCIL.

INTERMEDIATE TECHNICAL SCHOLARSHIPS, 1922.

The Council is prepared to award Intermediate Scholarships and Free Places in the undermentioned senior day technical courses:—

Engineering.—Northampton Polytechnic, Battersea Polytechnic, Finsbury Technical College.

Technical Optics.—Northampton Polytechnic.

Building.—L.C.C. School of Building, Northern Polytechnic, Regent Street Polytechnic (Architecture).

Chemical Trades (General). — Battersea Polytechnic, South Western Polytechnic, Finsbury Technical College, Northern Polytechnic (Works Chemists' course).

Chemical Trades (Special).—Leathersellers' Company's Technical College (leather manufacture), Northern Polytechnic (rubber), Borough Polytechnic (bakery and confectionery).

Musical Instrument Making.—Northern Polytechnic.

Boot and Shoe and Light Leather Manufacture.—Cordwainers' Technical College.

The scholarships and free places are, as a rule, tenable for two or three years, but not beyond the end of the school year in which the age of 19 is attained. They provide free tuition in approved courses, and (in certain cases) an annual grant, determined in accordance with the scale set out in Schedule 3 on page 48 of the Council's Scholarships and Training of Teachers Handbook, which can be purchased through any bookseller or direct from the publishers, Messrs. P. S. King and Son, 2 and 4, Great Smith Street, Victoria St., Westminster, S.W.1, price 3d., by post 4½d. From this schedule it will be seen that if the income of the parents (or guardians) is £550 a year, and there is no other child, the candidate will be ineligble for a scholarship or free place.

Candidates must be less than 18 and not less than 16 years of age on 31st July, 1922. They must be British subjects, and their parents (or guardians) must be ordinarily resident within the administrative County of London.

The selection will be made on the result of an approved "first" examination or, in special cases, on the reports of a Board

Application forms T may be obtained from Room No. 539, New County Hall, S.E.1, and they must be returned not later than 1st May, 1922. R. BLAIR,

Education Officer

Education Officer's Department,
New County Hall, S.E.1.
January, 1922.

SOUTH WESTERN POLYTECHNIC INSTITUTE.

An announcement is made of a course of 10 lectures on the "Chemistry and Technology of Petroleum," to be given on Thursday afternoons at 2 o'clock at the Polytechnic, Manresa Road, Chelsea, S.W.3. The lectures will commence on April 22. A practical class will be held immediately after each lecture at which demonstrations will be given of the apparatus and methods employed in testing and examining petroleum and petroleum products. The fee for the course is 10s. Further information can be obtained by applyin gto the head of the Chemical Department.

We have received the following announcement from the Editor of the *Yorkshire Evening News*, with request for publication:—

FRANCO GERMAN ENTENTE.

SENSATIONAL DYES AGREEMENT WITH GREAT FATHERLAND TRUST.

GERMANS TO HALVE FRENCH PROFITS.

(*Exclusive to the "Yorkshire Evening News."*)

The *Yorkshire Evening News* is in a position to make public the particulars of a remarkable commercial alliance which has been concluded between Germany and France. It is understood that the leading French dyestuffs company, "La Compagnie Nationale de Matières Colorantes et de Produits Chimiques," has come to an arrangement with the Interessen Gemeinschaft, the great German Dye Trust, commonly known as the "I.G." The Germans have agreed to give France all the technical assistance in their power. They will disclose the secrets of their laboratories; they will tell how these are carried out; they will furnish copies of their plant designs; they will even send trained German chemists into the French factories to superintend their secret processes in the actual manufacturing operations. The French, on their part, have undertaken that their output of dyestuffs shall be confined to the demands of France and her colonies, and they consent to hand over to the Ger-

THE "RADIO REVIEW."

From April 1st, the *Radio Review* is being incorporated with the *Wireless World*, and that in future the publication will be known as the *Wireless World and Radio Review*, and will be issued weekly.

The Journal of the Franklin Institute for March, 1922, contains an important paper upon Fogs and Clouds by W. J. Humphreys, C.E., Ph.D. The paper is accompanied by a large number of extremely fine photographic reproductions of clouds.

The subject is very exhaustively treated, and at the end will be found a discussion on clouds as weather signs. The paper concludes with a bibliography of the literature of the subject.

The same journal gives a valuable paper upon the production of Gasoline from oil shale, with a good deal of real information about the occurrence of oil shale in Utah, accompanied by photographic illustrations.

Much has been written recently in the Press about the possibilities of the production of oil from this source, and the paper will be found of value to those interested in the matter.

NOTES ON BOOKS.

The Storage of Petroleum Spirit and Carbide of Calcium for the use of local inspectors and motorists, by Major A. Cooper-Key, C.B. Second Edition; pp. x. + 133. London: Charles Griffin and Co., Ltd., 1921.

The author has prepared a convenient "primer" for the use of officials and for those who need, for any reason, to store petrol or calcium carbide.

He is exclusively concerned with the legal aspect of the subject, and only deals with the chemical and other tests, and with the properties of the various products in so far as these have a bearing upon the carrying out of the Petroleum Acts and Orders. These Acts and Orders, 1871—1919, are given in the form of useful appendices.

For those concerned, this little volume will be found very useful. J.G.F.D

Fixed Oils, Fats, Butters, and Waxes: Their preparation and properties, and the Manufacture therefrom of Candles, Soaps, and other Products, by C. R. Alder Wright, D.Sc. (Lond.), B.Sc. (Vict.), F.R.S. Third Edition, revised and greatly enlarged by C. Ainsworth Mitchell, M.A. (Oxon), F.I.C.; pp. xiv. + 940 + 3 plates. London: Charles Griffin & Co., Ltd., 1921. Price 56s.

This invaluable treatise has now reached its third edition, and it completely maintains the high standard of excellence reached by its predecessors. The literature relating to the chemistry and technology of fixed oils and fats is already voluminous, and yearly increases. The selection of important achievements and advances from among the numerous publications is a difficult one. The authors have accomplished this task in bringing their volume up-to-date.

The scope of the work embraces the general composition and nature of oils, fats, waxes and allied bodies, and their physical and chemical properties, etc. Industrial and analytical processes are given very fully, and the same applies to the authors' treatment of the candle and soap industries. All the processes that these substances undergo for their various uses are adequately described. The illustrations are also very well executed.

We think, however, that such well-known authorities might have given more guidance to the uninitiated by indicating which analytical processes were those commonly adopted at the present time. All methods receive equally detailed treatment.

Two appendices deal respectively with reports on standard analytical methods issued by the Ministry of Food, and with the important subject of Vitamines.

The authors and publishers have spared no efforts to make the book of the greatest utility to chemists, who will find it most invaluable and indispensable as a standard work of reference. J.G.F.D.

The Elements of Fractional Distillation, by C. S. Robinson; pp. ix. + 205. New York: McGraw-Hill Book Co., Inc., 1922. Price 12s. 6d. net.

Apart from Sydney Young's classical volume, very few books have appeared in English which deal with fractional distillation.

In the present volume the principles of fractional distillation are explained in accordance with our knowledge of Physical Chemistry and Chemical Engineering.

Early chapters deal with the subject from the qualitative standpoint of the Phase Rule, and the more important laws of physical chemistry are discussed in so far as they concern distillation phenomena. The quantitative aspects are then considered, especially from the view-point of the chemical engineer. Intermittent and continuous processes of fractionation are compared. The separation of pure ammonia from the crude liquor, benzene from light oil, methyl alcohol from wood spirit, and ethyl alcohol from fermentation products are adequately described. These processes are illustrated with excellent figures which enhance the value of the book. An appendix supplies very useful information in the form of Vapour Pressure curves, tabular data, and a bibliography.

We notice that, although the book generally attains a high standard whenever dealing with industrial matters, little is said concerning steam distillation. A few other minor errors occur. The text on page 12 does not quite agree with the lettering of the figure. In the table on page 190, quinoline is spelt in German, evidently just as it is taken from Rechenberg's treatise; "Chimie" is wrongly spelt twice on page 198.

These small and obvious mistakes should not detract from the unquestionable value of this important work. J.G.F.D.

BOOK NOTES

Readable School Physics, by A. J. Cochine, B.Sc. Published by G. Bell & Sons, Ltd., London, 1922. Price 2s. 4d.

As might be gathered from the title, the author has endeavoured to present the subject of elementary physics in such a manner as to engage the interest of the young student. The book is quite small, occupying only some 31 pages, and is profusely illustrated. Half-tone pictures are given of many of the prominent leaders in science, and many interesting drawings from ancient and modern works.

At the present day, when the need of the universal knowledge of at least the elements of practical science is becoming fully recognised, this little work will be found of the greatest possible value. The subject is certainly introduced, as the title suggests, in a readable form, and it is just the book to give to any boy, or girl either, who has the desire for scientific knowledge. The author's method of teaching is very similar to that employed by the late Professor Pepper in his well-known Playbook of Metals, dear to many of us in our younger days. We can confidently recommend the book for use both at home and in schools, and we hope that the author will soon see his way to produce a similar work dealing with elementary chemistry.

Directory of Papermakers of the United Kingdom for 1922. 64th annual publication. Marchant, Singer & Co., 47, St. Mary Axe, E.C.3. Price 5s. net.

The Papermakers' Directory has been revised and brought up-to-date, and it contains lists of papermakers in the United Kingdom, papermakers' representatives, London wholesale stationers, &c. In addition to the above information there is given a complete list of the watermarks used by papermakers, arranged in alphabetical order, with the name of the manufacturer.

This section is followed by a similar one devoted to trade names—not being actual watermarks.

At the end of the book there is given a collection of paper trade customs, etc., which will be found of great value to stationers and publishers. The book contains a great number of advertisements, classified so as to form in itself a useful directory of papermakers and suppliers. J.H.G.

Lektrik Lighting Connexions. 7th Edition, 80th thousand. A. P. Lundberg & Sons, Pioneer Electrical Works, 477/489, Liverpool Road, London, N.7. Price 1s., post free 1s. 2d.

This handy little treatise on electric connexions and switches gives full details of the various methods of connexions used in present day electric lighting. The booklet will be found of the greatest value to practical electricians, who indeed cannot afford to be without it.

Full details are given of a scheme for free home examinations in electric light switching, which has alreay proved to be of the greatest use to practical electricians. In this 7th edition many improvements in

present-day wiring have been introduced, and the book has been very thoroughly revised. The illustrations given are clear and easy to follow. The work is clearly printed on good quality paper, and is not too large to be conveniently carried in the pocket.

J.H.G.

Organic Chemistry, or the Chemistry of the Carbon Compounds, by VICTOR VON RICHTER, edited by Prof. R. Anschütz and Dr. H. Meerwein. Vol. II., Chemistry of the Carbocyclic Compounds. Translated from the eleventh German edition by E. E. Fournier d'Albe, D.Sc., A.R.C.Sc. London: Kegan Paul, Trench Tribner & Co., Ltd., 1922. Price 35s. net.

Richter's "Organic Chemistry" has now become so indispensable as a book of reference for organic chemists that this volume, which is a translation of the German edition of 1912, will find a place in many scientific libraries.

The present edition has been somewhat enlarged to include recent discoveries. The most important interpolations are those incorporating new work on the polymethylenes, halogen and nitrogenous derivatives of the hydrocarbons, phthaleins, condensed nuclei and glucosides.

The discovery of the long sought o-benzoquinone fills a previous gap; other new and more complex quinones are also included. The exceedingly numerous researches made in terpene chemistry have considerably enriched the section of this subject.

The translator has retained the German names for benzene and its homologues, viz., benzol, etc., and on page vi. has translated *Kohlenwasserstoff* into *Carbohydrate*!

Organic chemists whose knowledge of German is slight should prefer the present volume to other works or references of this type.

Recent Advances in Physical and Inorganic Chemistry, by A. W. STEWART, D.Sc., with an Introduction by the late Sir William Ramsay, K.C.B., F.R.S. Fourth Edition; pp. xvi. + 286 + 1 plate. London: Longmans, Green & Co., 1920. Price 18s. net.

This edition of Professor Stewart's "Recent Advances in Physical and Organic Chemistry contains new matter not included in its predecessor. The chapter dealing with the position of the Rare Earth elements in the Periodic Classification has been extended. Results of recent investigations on mass-spectra, transmutation and siotopes have been incorporated. A new chapter has been written on the Periodic Law, and modifications have been made in the Atomic Volume curves. To make room for this matter the chapters on the Pseudo-acids and the Inert Gases have been deleted. The author has generally selected suitable material for a textbook which is widely read by students. However, some of the matter can scarcely be claimed to fall within the domain of chemistry. Recent work on X-rays and positive-ray analysis is highly important, but is more likely to be sought in up-to-date textbooks on pure physics. The long chapter on Absorption Spectra could have appeared equally well in the author's companion volume, "Recent Advances in Organic Chemistry."

The four-page attack on Ostwald appears undignified in view of the international inter-dependence of science and scientists, and also represents no recent advance in Chemical Science.

Students will consult this readable volume to gain information on the latest developments in chemistry, and except for a few controversial hypotheses and the above mentioned points, the author has presented them with a very suitable volume.

The Analysis of Dyestuffs and their Identification in Dyed and Coloured Materials, Lake-pigments, Foodstuffs, Etc., by ARTHUR G. GREEN, M.Sc., F.R.S., F.I.C. Third Edition; pp. xii. + 150. London: Charles Griffin & Co., Ltd., 1920. Price 10s. 6d.

Since the first edition of this book appeared in 1915, the dyestuff industry has experienced considerable developments, particularly in England and America. Dyestuffs previously made only in Germany are now manufactured here, and many have received new trade names. Since the author regards them as of ephemeral nature, he does not include them in his thirty-one analytical tables, but he has indexed them with cross references to the older names.

The important new feature of this edition is Doctor J. M. Matthews' alphabetical tabular "Key to Trade Designations."

In this particular branch of applied chemistry there is a great need for simplification of the nomenclature. The book will be of great service to analysts who are in any way concerned with dyestuffs.

Isotopes, by F. W. Aston, M.A., A.I.C., F.R.S.; pp. viii. + 152. London: Edward Arnold & Co., 1922. Price 9s. net.

As long ago as 1886 Sir William Crookes urged the possible heterogeneity of the elements, and suggested that the metal calcium for instance, might contain some atoms of Atomic Weight 39, and others 41, or 38 and 42, etc. His laborious fractionations of the rare earth salts had brought him to this conclusion. Radioactive disintegration has more recently (1910) given renewed prominence to his views. The recent results of positive-ray analysis have now confirmed these conclusions, and there is a marked tendency at the present time to revert to a modification of Prout's hypothesis.

The present knowledge of the existence of two or more of isotopes in the case of about fifteen elements gives a satisfactory explanation of the constancy of the chemical atomic weights which are also in excellent agreement with the mean atomic weights deduced by means of the Mass Spectrograph.

Attention is thus drawn to the unsatisfactory definitions given to the term "element," none of which satisfy the demands of the human intellect.

Much has been attempted in order to effect the separation of isotopes. Various ingenious methods of diffusion and fractional distillation have been tried.

Photochemical methods have also been suggested. So far these have met with a very limited amount of success.

Comparatively little is said concerning the Radioactive isotopes, but the author trusts that some other investigator in this field will produce a monograph dealing exclusively with them.

It is regrettable that several errors have been made in the references to the literature. Thus, on page 141 and in the index, Professor Brauner's name is spelt "Braun."

The author has prepared this volume to meet the requirements of teachers and students of Physics and Chemistry who wish to acquire a knowledge of this subject which has recently assumed an important position. He has succeeded in presenting his subject in an interesting manner, which will appeal to those who cannot wade through the literature for the scattered papers on the subject.

GENERAL NOTES—*Continued.*

AUSTRALIA.

TENDERS INVITED FOR DRY AND POROUS CELLS AND ACCESSORIES.

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Local representation is essential, and the Department will be pleased to supply United Kingdo mfirms not already represented in Australia with the names of agents who may be willing to act for them.

New Patents.

This list is specially compiled for *Chemical News* by *Messrs. Rayner & Co., Registered Patent* Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

8159—Barton, G. V. Apparatus for manufacture of lead oxide. March 21.

8483—Chemische Fabriken Grunan Landshoff & Meyer Akt Ges.—Process for production of an anti-syphilis substance. March 23.

8105—Evans, E. V.—Purification of gases from hydrogen sulphide. March 20.

8375—Imray, O.Y.—Manufacture of a derivative of *pyradolone and of dye-stuffs therefrom.* March 22.

8172—Lebbin, G.—Process for production of carbonic acid baths. *March 21*

8615—Lessing, R.—Manufacture of neutral sulphate of ammonia. March 24

Specifications Published this Week.

176,400—Pattison, E. W.—Recovery of ammonia in the ammonia soda process.

154,938—Fleischer, Dr. E.—Manufacture of coal distillation products.

176,588—Pearson, A.—Manufacture of zinc oxide.

161,757—Merck, E.—Process for the preparation of tropinone mono-carboxylic-acid esters.

176,729—Dyson, W. H.—Purification of ores and residues containing oxides of chromium.

Abstract Published this Week.

Protecting Unstable Substances.—Patent No. 174,891.—A treatment of sodium hyposulphite, sodium perborate, and other per-salts has been invented by Mr. A. Welter, of Rheinhafen, Krefold, Germany.

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PATENTS AND DESIGNS ACTS, 1907 AND 1919.
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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3237.

PLATINUM.

By George F. Kunz.

The platinum industry is gradually emerging from the chaotic condition into which it was thrown by the cutting off of the Russian supplies, and by the coincident intense demand for the metal in connection with the manufacturing of war materials. The Russian sources, both new and old, are slowly coming to the front again, and the increased production in Colombia, at first greatly stimulated by the cessation of Russian shipments, has been rendered more stable and promising by the organisation of powerful companies, financed in the United States. At the same time some much-needed laws have been enacted to insure the purity of articles purporting to be made of platinum or of the other platinum metals. Although the special war demand has largely ceased, its place is taken by a revival of the demand for jewelry and dental uses, while the needs of the chemical industries are constant and permanent. As a result of these various factors the price of platinum, although it has fallen decidedly from the high mark of 1919 and the first half of 1920, maintains itself at from 70 to 75 dollars an oz., and it does not seem likely to fall much beneath these figures. Iridium, however, because so much rarer, and because of its necessary employment to give hardness and stability to pure platinum, continues to command a much higher price per ounce than the latter metal. Taken in its entirety, the present aspect and the future prospects of the platinum industry are such as to encourage every effort to open up new sources of production and to develop more extensively the older sources.

The Platinum Stamping Law of New York State, which went into effect Sept. 1, 1920, does not require that a manufacturer shall stamp any article made of platinum, but merely provides a standard for stampinging in case the dealer wishes to set such a mark on such of his wares as contain platinum. Nevertheless this law provides an effective guarantee for a purchaser against any misrepresentation on the part of the dealer, for if an article is made of platinum, in combination with the metals resembling platinum, and a dealer stamps, bills, or marks this article as being of platinum, it must conform to the standard of 925 thousandths fine, or else the law has been violated. Moreover, the dealer may not take refuge in his ignorance of the lack of conformity to the standard, for he is regarded as responsible for the genuineness of the article he sells, that is to say, for its conformity to the stamp or mark it bears, or to the designation under which he sells it. The term "platinum," however, includes all metals of the platinum group, the totality of such metals being included in the 925 thousandths required by the law.

The decision of the Board of United States General Aplraisers, rendered Dec. 30, 1920, was believed to settle definitely the status of irido-platinum sheets as imports, and to affirm the claim that they share in the provisions of paragraph 578 of the tariff act of 1913, exempting "platinum, unmanufactured, or in ingots, bars, plates, sheets, wire, sponge or scrap," and are not subject to the 50 per cent. ad valorem duty imposed in paragraph 167 on "articles or wares, composed wholly or in part of platinum." The fact that platinum needs the added hardness imparted by an admixture of iridium in order to render it satisfactorily available for industrial or artistic uses, is too well known to require notice here.

The great rise in the value of platinum has caused an urgent demand for it in a quarter whence this demand is not desired. We mean from that section of the community whose members live by thieving. Not long since, a New Jersey manufacturing concern reported that 75,000 dollars of the precious metal had been stolen; a good portion of this has been fortunately recovered, it is said. It is not stated, however, that equal good luck has been enjoyed by the Department of Agricultural Chemistry at the University of Missouri, from whose vault had been stolen the entire stock of platinum crucibles, weighing in the aggregate as much as 2,500 grams, worth nearly 6,250 dollars at present rates. Other institutions also are said to have been despoiled in this way. Indeed, in one instance an entire university laboratory was burned down to hide the theft of platinum. Chemical laboratories and mineralogical museums seem to be the greatest sufferers, unhappily in many cases through those employed in them.

It has been suggested by Dr. W. F. Hillebrand, Chief Chemist of the Bureau of Standards, that a stop might be put to the platinum thefts if a proper system of platinum registration should be required. As the only really effective legislation on this matter ought to have a national scope, and be enacted by Congress, it would be necessary to have it based upon conditions affecting interstate commerce, so as to bring it within the sphere of congressional prerogative, unless, as has also been proposed, the matter could be brought under the control of the internal revenue department, by levying a very small sales tax upon platinum. This tax need not exceed one-tenth of 1 per cent., just enough to pay for the expense of the registering agencies. The importance of some such legislation is emphasised by the fact that on one occasion more than 10,000 dollars worth of platinum was stolen from the Bureau of Standards, and the University of Michigan and the University of Wisconsin have also been sufferers in this way. A still heavier loss, of 40,000 dollars worth of the metal, was inflicted upon a manufacturer in the neighbourhood of New York City. It is also reported that there were taken from the U.S. Smelting, Refining, and Mining Co., of Midvale, Utah, on Feb. 20, 1920, apparatus amounting to 5 oz. troy, while from the chemical laboratory of Wells College, between Feb. 12 an d15, 1920, thieves made off with a number of platinum articles weighing about 16 troy oz. With platinum at 70 dollars or 80 dollars an ounce this constitutes a serious loss.

An adequate idea of the value of recent platinum thefts is given by two trials before the Federal Court at Nashville, Tenn., on April 7, 1921. In the first case the jury found a verdict of guilty against the accused, on a charge of embezzling 26,000 dollars worth of platinum from the Government, while he was employed as chief chemist at the Old Hickory powder plant at Nashville. The same offender was charged with having embezzled 188,200 worth of platinum, in addition to the 26,000 dollars involved in the first trial, and was found guilty on this charge as well.

A novelty in the art of thieving platinum is reported fromFrance. On the towers of the famous Cathedral of Notre-Dame in Paris, the lightning rods have been tipped with platinum as a protection against heaven's artillery. This circumstance induced a gang of thieves to cut their way through a panel of the massive oak door barring the way to the tower stairway, and to perform the same operation on three other successive doors. Once on the platform of the towers, they sawed through the copper lightning rods, and dismounted them so that they were able to take off the platinum balls with which they were tipped. These weighed about half a kilogram, or 16 oz., worth at least 1,000 dollars, or about 13,000 francs at present exchange. Another similar case is the reported stealing of platinum lightning-rod tips from three of the French forts on the Italian frontier.

United States Platinum Production and Imports in 1920.

Estimates of the production of crude placer platinum in the United States in 1920 give Alaska, 27 oz. troy; California, 656 oz.; Oregon, 23 oz.; and Washington, 8 oz.; total, 714 oz. troy.

Refiners reported a production of 41,544 troy oz. of new platinum metals in 1920, of which 36,015 oz. was platinum, 418 oz. iridium, 409 op. osmiridium, 4,309 oz. palladium, and 393 oz. of the minor platinum group metals, including rhodium and osmium. This represents a decrease of 3,565 oz. as compared with the production in 1919.

Chem. Met. Eng., July, 21, 1920.
U.S. Geol. Surv.

There was also produced 57,710 oz. of secondary platinum metals in 1920, of which 51,255 oz. was platinum, 3,355 oz. iridium, and 3,100 oz. palladium. This represents a decrease of 3,806 oz., as compared with the production in 1919.

The platinum metals imported for consumption in 1920 included 80,955 oz. of crude platinum and unmanufactured ingots, bars, sheets, etc., of which approximately 58,009 oz. is believed to be refined metal; 4,718 oz. of iridium; 4,473 oz. of osmiridium; 6,944 oz. of palladium; 2,675 oz. of the minor metals; and 781 oz. of manufactured platinum ware.

The consumption of platinum metals in the United States in 1920 was 141,041 oz., of which the jewellers took 57 per cent., the electrical industry 19 per cent., the dental industry 11 per cent., the chemical industry 10 per cent., and miscellaneous uses 3 per cent.

The stocks of platinum metals at the end of 1920 amounted to 67,508 *oz.*, which is an increase of 55 per cent. as compared with the stocks at the end of 1919.

The following table shows the amounts of new platinum and other metals of the platinum group that were recovered by refiners from gold bullion, nickel and copper in the United States in the years 1918—1920.

Year.	Platinum. Troy oz.	Platinum. Grams.	Iridium, Troy oz.	Osmiridium, Troy oz.	Palladium, Troy oz.	Rhodium, Troy oz.
1915	6,495	202,017	274	335	1,541	—
1916	24,518	762,596	370	315	2,885	—
1917	33,009	1,026,695	210	833	4,779	—
1918	54,399	1,691,999	465	539	4,024	326
1919	40,220	1,250,983	401	402	3,807	279
1920	36,015	1,120,175	418	409	4,309	393(a)

(*a*) Includes osmium.

Alaska.—It is reported that the gold placers of the Chistochina district (State Creek), in the south-eastern portion of Seward Peninsula, and also in some other districts, continued to produce small quantities of platinum in 1920.

The Salt Chuck mine (formerly the Goodroo mine), situated between Lake Ellen and the source of Salt Chuck creek, at the head of Kasaan Bay, Prince of Wales Island, Alaska, was originally operated for its low-grade copper deposit, but subsequently the platinum and palladium content were found to be more valuable than the copper, so that it is now termed a "palladium-copper mine." Work has been carried on there continuously since 1917, some 16 miners being employed in 1919. The deposit occurs in an area of course-grained intrusive pyroxenite rock, of the kind which invades the paleozoic sedimentary rocks of Kasaan Peninsula at many localities. The ore minerals consist of sulphides in grains and small patches in the pyroxenite. Bornite is the chief copper mineral, but a little chalcopyrite occurs locally. Both chalcocite and covellite are present, as alteration products of the bornite and chalcopyrite. Besides palladium, a little gold, silver and platinum is recovered. As partial tests have shown the presence of somewhat more than 3 *oz.* of palladium to the ton of concentrate, and as a ton of concentrate represents about 28 tons of ore, there would be a palladium content of a little over one-tenth of an ounce to the ton of ore. The proportion of the palladium to the small amount of platinum in these deposits is estimated at about 50 to 1. Each ton of ore is figured to contain about 28.5 lb. of copper. At 12 or 13 cts. a lb. the copper woul donly be worth from 3.40 to 3.70 dollars, while the 0.1 oz. of palladium might be valued at 12 or 13 dollars.

The company organised to exploit the platinum and palladium deposits of Kasaan Bay, Alaska, has a capitalisation of 150,000 shares issued at 10 dollars each. The company owns 29 full mining claims and 16 partial ones, and the statement is made that out of one-tenth part of a claim, opened up to a epth of 150 feet, ore worth 400,000 dollars has been secured. The material is sold to the smelting works in Irvington, N.J. In all, it is asserted that 200,000 tons of ore has been extracted, the net value of this being about 1,000,000 dollars. Should all expectations be realised, this Alaskan field would make quite a notable contribution to the world's production of platinum.

(*To be Continued.*)

THE VOLUMETRIC DETERMINATION OF TiO_2 IN BAUXITE.

By H. J. Winch, A.C.G.I., F.I.C., and

V. L. Chandratreya, B.A., B.Sc. (Hons.), (Poona).

Owing to dissatisfaction with the gravimetric methods, the following volumetric method was worked out in the Shivrajpur Mines Laboratory.

The method depends on the complete reduction of all Iron and Titanium Salts to the ferrous and titanous state by Tin in HCl solution, elimination of the excess of $SnCl_2$ by $HgCl_2$, and finally the conversion by the titanous salt of an equivalent amount of ferric salt to ferrous state.

Titration gives a result for the Fe_2O_3 and TiO_2 present. The figure for TiO_2 is obtained by deduction of Fe_2O_3 estimated by a simple Fe determination.

0.3 Grm. of the dried ore is mixed in a platinum crucible with about 10 times its

weight of $KHSO_4$, and gradually brought the crucible between the hands and transferred to a beaker, any portion remaining in the crucible being extrateed with hot dilute HCl and added to the contents of the beaker. The bulk should be kept as low as possible.

Strong HCl is added, and the melt dissolved by boiling. The solution is transferred to a conical flask and 0.15 grm. of pure tin powder (free from Fe) with 5 grms. of NH_4Cl added.

The flask is loosely closed by a small funnel with a small watch glass upon it, and the contents gently boiled until all Sn is dissolved. It is sometimes necessary, if the solution proves too dilute, to add a further quantity of strong HCl to expedite the solution of the Sn.

When this is complete, cold recently boiled water is quickly added from the sides of the flask, and then 50 cc. of a solution of $HgCl_2$ of a strength of 40 grms. per litre, which quantity is sufficient to ensure complete elimination of the balance of $SnCl_2$ present.
into fusion until the melt is clear. It is kept fused for 15 minutes, and the crucible then tilted and allowed to cool. The contents are cracked out by gentle rolling of

The contents, which should be about 300 cc., are quickly agitated, and about 5 cc. added of a solution of Ferric Chloride (free from Ferrous Iron) of a strength equivalent to about 10 grms. of Fe per litre. The quantity added must be more than sufficient to convert all $TiCl_3$ to $TiCl_4$. The solution is shaken and titrated against standard K_2Cr_2O , solution using potassium ferricyanide indicator drops ou a porcelain plate until no blue colouration is obtained, as is usually done in the determination of Fe by K_2Cr_2O .

The result is calculated to the total Fe_2O_3 and TiO_2 present, the factor being the same for both. The time taken for this determination is 2-3 hours.

It may be noted that this titration may be made without the addition of $FeCl_3$, but the advantages claimed for the addition are:—

(1) The indication of the end of the titration is much more sharply defined.

(2) The danger due to the rapid oxidation by atmospheric oxygen of titanous salts is avoided.

For the determination of Fe_2O_3 alone, a separate portion of 0.3 grm. is similarly fused and dissolved, transferred to a Phillipps beaker, evaporated to 50 cc. bulk and a little NH_4Cl added. when the Fe is reduced in boiling solution by the addition of dilute $SnCl_2$ solution, drop by drop at the finish, until the yellow colour just disappears.

Cold boiled water is added up to about 300 cc., and the solution straightaway titrated against the same K_2Cr_2O standard as before.

The difference between the two results calculated to Fe_2O_3 gives the quantity of TiO_2 present owing to the factor for each being the same.

This method has been etxended with most satisfactory results to the analysis of rocks, clays and shales containing Titanium.

Shivrajpur Mines Laboratory,
Shivrajpur, Panch Mahals,
Bombay Presidency.

A CENTURY OLD CHEMICAL DICTIONARY.

By James F. Couch.

(Reprinted from the "American Journal of Pharmacy," January, 1922)

In a recent little volume Dr. Edgar F. Smith has described the life-work of one of the earliest of American chemists, James Cutbush. While the whole essay will prove of interest to the scientific reader, pharmacists will be especially interested in learning that Cuthush styled himself "chemist and apothecary," and that, in 1812, he advertised a course of lectures on "theoretical and practical pharmacy" probably delivered "at the Laboratory in Videl's Court, in Second, near the Corner of Chestnut St.," in Philadelphia.

It is not my purpose to discuss the excellent contribution of Dr. Smith. That has already been most satisfactorily done by the pleasing pen of Dr. C. E. Munroe. But I wish to call attention to one of the many publications of Cutbush, perhaps not his most important contribution to American scientific literature, but one which serves the very useful purpose of a base from which to measure progress. In 1821, a century ago, Cutbush published his "A Synopsis of Chemistry, Arranged Alphabetically: comprehending the names, synonima, and definitions, in that science."

This is a little book of 85 pages, 9 by 14 cm. in size, bound in boards, and it appeared at the time when the author was actin gprofessor of chemistry and mineralogy in the United States Military Academy.

The chief interest of this work is that it presents a general view of the state of chemical knowledge just a century ago, and permits us to observe the advances and the changes which the past hundred years of intensive scientific activity have occasioned.

Much of the old involved nomenclature of early chemistry is present. We read of "hydriocyanic acid" (p. 30), and of "hydro-oxydates" (p. 31) yet, throughout the book, there is a minimum of this sort of terminology and the whole is clear, concise, and phrased in simple language. There is not a chemical formula in the entire text which is not surprising for the theories of valence were not yet formulated. We must remember that Kolbe was born in 1818, Frankland in 1825, and Kekulé in 1829.

James Cutbush, "An American Chemist," 1919.
Book Review, *J. Am. Chem. Soc.* 43, 1743 (1921).

Some of Cutbush's definitions can hardly be improved upon at the present day. Chemistry he defines (p. 17), "That science, which treats of the action of bodies on each other, and having, for its object, the discovery of their constituent principles, the results of the various combinations, and the laws by which these combinations are affected." Analysis is defined (p. 10), "The separation of a substance into its constituent parts." Carbonates (p. 15), "Salts formed by the combination of carbonic acid with a base." He possessed a clear idea of neutralisation, (p. 45), "When certain substances unite, and lose their individual properties, they are said to neutralise each other."

Cutbush, too, was up-to-date. He speaks of "molecules," of iodine, which had recently been discovered, of compounds (although he does not define this term), and says of "phlogiston" (p. 52), "An imaginary element. A constituent part, it was thought, of all inflammable bodies."

He includes notices of "morphia," "nicotin," and "strychonin." Of maceration he says (p. 37), "The process of softening a substance, by steeping it in a fluid, without impregnating the latter." This is, of course, quite contrary to the modern meaning of the term. Rectification is (p. 63) "Distillation repeated as often as circumstances require."

The erroneous or primitive ideas prevalent at the time find expression in the definitions for latent heat (p. 36), "Heat chemically combined, not appreciable by the senses," oxydes (p. 49), "Combinations of oxygen with different bases, not possessing, strictly speaking, acid properties," and for affinity which may be "single," "double," or "disposing." Disposing affinity apparently is emulsification; double affinity is what we should now term double decomposition. Single affinity is defined (p. 7), "When two bodies are united and are separated by a third, single affinity is said to take place." Hydrogen peroxide is termed "peroxidised water" (p. 51) and fermentation (p. 24) is "A peculiar spontaneous process, which bodies undergo, when exposed to a proper degree of heat, and for a certain length of time." Nevertheless we suppose that the factitious blondes were as attractive and the brewed products as seductive then as at any time since.

Magniloquent titles are not lacking; bread making is "panification" (p. 51), the art of assaying metals is the "docimastic art" (p. 22), "eliquation" is the separation of substances by fusing out one of them. Sir Humphrey Davy is accused of fathering the terms "phosphorane" and "phosphorana" for the tri- and penta-chlorides of phosphorus respectively (p. 52).

Boric acid is termed "narcotic acid" (p. 45) and "narcotic salt" (p. 6). While nitrogen is "mephitic gas" (p. 11), carbon dioxide is "mephitic acid" (p. 39). Carbonic acid is "calcarious acid" (p. 14), and the "acid of sugar" or "saccharine acid" is oxalic acid (p. 72) probably in reference to its production by heating sugars with nitric acid. Coagulation is defined (p. 18), "An operation by which fluids are made clear, by the use of serum and albumen, and the application of heat." "Butter of Arsenic" is arsenic pentachloride (p. 14) and "green fecula" is the term given chlorophyll (p. 24). A gas is (p. 27) "A combination of a base with caloric; as hydrogen and caloric, forming hydrogen gas." Elements (p. 23) are

"first principles. Simple substances. Undecomposable substances," and effervescence is "the sudden escape of a gaseous substance, accompanied with an intestine motion," (p. 23).

As an instance of the medical superstition then prevalent, Cutbush's definition of "miasma" may be quoted. "Matter of contagion. Certain bodies are known to exist in the atmosphere, we will not say combined with it, which exert a powerful action on the human body, and which have been termed *matter of contagion.* Miasmata may proceed from the decomposition of vegetable, or of animal substances, and the atmosphere may be tainted by other causes. In all cases, however, it has been supposed that a certain noxious matter is dissolved in, or diffused through the air, and that by the action of this matter on the living body certain diseases are produced. When noxious effluvia arise from putrefaction, it is known that certain agents will destroy it; hence the vapor of nitric acid ,of muriatic acid gas, and of oxymuriatic acid gas, or chlorine, have been used with great success, in disinfecting air." (p. 41).

From the foregoing one can appreciate the mists which clouded the conceptions of chemists a century since. Superstition, thaumaturgy, fallacy had to be removed, a science had to be organised and a simple practical system of notation had to be invented. Very little of our present chemical knowledge existed, and what there was appears ill-defined and co-ordinated. The tremendous importance of the contributions of such men as Berzelius, Liebig, Dumas, Gerhardt, Pasteur, Faraday, van't Hoff, and Fischer, with their contemporaries stands forth in *alto relievo* when we contrast the present year with hundredth predecessor.

Much of Cutbush's text is now only curious; some of it is rather absurd. We cannot help but hope, however, that since this sort of thing is one way of measuring progress, our successors in 2021 will find much of our present though ancient and perhaps a trifle ludicrous.

"FLUORINE."

The Most Active Element Known.

By John Missenden, B.Sc.

Fluorine is an elementary substance closely allied to chlorine, it being the only other gas belonging to the halogen group and possessing somewhat similar active properties.

In 1887, Moissan succeeded in isolating it to a certain extent by resorting to a process of electrolysis, the electrolyte being liquid hydrofluoric acid free from water, but with a slight addition of potassium hydrogen fluoride to render the liquid electrically conductive. The experiment was carried out in a platino-iridium U-tube (the hydrofluoric acid, q.v., readily attacking glass), and the fluorine was set free at the anode, hydrogen being freed at the kathode.

The chief source of fluorine, for the purposes of commerce, is:—

Fluorspar (or *Fluorite*), a mineral which consists mainly of calcium fluoride, CaF_2.

Physically, it is a crystalline substance which assumes the cubic system, very perfect and many coloured crystals being formed. These are commonly found in such localities as Illinois and Indiana in U.S.A., in the volcanic regions of Italy, and in Derbyshire and Cornwall. It is generally associated with the ores of lead, tin, copper and silver. Mostly, it occurs in veins, but it is also found in some of the dusty cavities in granite as well as in veins in limestone, sandstone, slate and crystalline schists. In the Derbyshire mines, where it is known to the miners as "Blue John," it is a common practice to make ornaments out of fluorspar—so massive are the crystals—so, that it is often called by the alternative name of Derbyshire spar.

As well as containing fluoride, it sometimes contains small quantities of calcium chloride, $CaCl_2$, and, less frequently, some organic matter which occasionally becomes so abundant as to emit a fetid odour—hence the name *fetid-spar* (stench-fluss: Ger.)

Other sources of fluorine may be mentioned in *cryolite*, sodium aluminium ferride (Na_3AlFe_6), and a few other minerals such as the igneous rocks, natural waters, and certain animal tissue (bones, teeth, blood and milk), but it is only present in minute quantities in these substances while it is present in fluorspar to the extent of 51.18 per cent.

It has a very powerful action upon such substances as glass, gold and platinum, consequently any attempts to isolate it in vessels made of these metals is futile. The only material that can more or less withstand its action must be composed of an alloy of platinum and iridium in fixed proportions, and it was a vessel of this description that was used by Moissan.

In appearance, fluorine is a pale yellow gas, and is possessed of an extremely irritating odour. At -187° C. it may be liquified, and still retains its yellow tint. It can be solidified at -223° C. Chemically, it is the most active elementary substance known. It decomposes water readily, liberating ozone O_3. With such substances as hydrogen, carbon and silicon it unites with such violence as to generate great heat, causing an inflammatory union. Also, it combines with iodine and bromine, two other elements of the halogen group, to from fluoric iodide and fluoric bromide. Such substances as phosphorus, arsenic and sulphur offer themselves for ready combination; while it will attack magnesium, sodium, potassium, mercury and other metals. Indeed, the only elements that it does not have any visible effect upon are oxygen, nitrogen and chlorine.

Hydrofluoric acid (or *hydrogen fluoride*), HF, is the acid analagous to hydrochloric acid, but it is far more active.

It is generally prepared by heating in a lead still a mixture of two parts of sulphuric acid with one part of fluorspar, the following action taking place:—

$$\underset{\text{(fluorspar)}}{CaF_2} + \underset{\text{(hyd. sulphate)}}{H_2SO_4} = \underset{\text{(hyd. fluoride)}}{2HF} + \underset{\text{(calc. sulphate)}}{CaSO_4},$$

the two molecules of hydrofluoric acid being driven off and conducted to a freezing apparatus by means of lead pipes, leaving the calcium sulphate and the other part of the sulphuric acid—which has acted as a catalyst—in the still.

When prepared in its most concentrated form, hydrofluoric acid has a density of 1.06, and is a colourless fuming liquid, highly volatile and with a boiling point of 15.5° C.

Its most useful property is demonstrated by its action on glass. It attacks the silica contained therein, and thus may be used for etching on that substance.

Fluorsilicic acid, H_2SiF, is obtained by the decomposition of silicon fluoroform by water or alcohol. It is not commercially important.

Fluortype. This expression will be familiar to photographers who have a preference for the softer form of negative. The process consists of coating a plate to be exposed with a fluoride solution which, afterwards being developed, has to be intensified with a solution of ferrous sulphate, $FeSO_4.5H_2O$, and fixed with the usual mixture of sodium hyposulphite and water. The process was first introduced in 1844.

CHEMICAL NOTICES FROM FOREIGN SOURCES

CATALYTIC DECOMPOSITION OF SHARKS' OIL—*Alphonse Mailhe.*—When sharks' oil is subjected to decomposition and hydrogenation, it behaves in exactly the same way as the vegetable oils, linseed and colza. When the vapour is passed over a catalyst composed of aluminium and copper mixed and heated to 600°-650°, liquid and gaseous products are formed. The latter, when freed from acrolein, consist chiefly of hydrogen and hydrocarbons. The former are treated with dilute soda to neutralise the acids, and then a strong smelling yellow liquid is obtained which can be hydrogenated over divided nickel at 180°-200°. Thus a colourless product with an agreeable smell is obtained, which gives a straw coloured colouration with sulphuric acid. It can be separated into various portions by fractionation, and those obtained between 70° and 150° contain aliphatic, aromatic and cyclo-aliphatic hydrocarbons, the last predominating. The portion distilling over between 135° and 140° contains metaxylene, meta-hexahydroxylene and aliphatic hydrocarbons. Above 150° each fraction consists of hydrocarbons, most of which are attacked by a sulpho-nitric mixture. The acid products obtained by the decomposition of sharks' oil include unsaturated acids which on hydrogenation give œnanthyllic acid, pelargonic acid, and lauric acid, besides possibly other lower acids. Acetic acid has not been identified among the products.—(*Bull. Soc. Chim.* XXXI.-XXXII., 1922, No. 3.)

UNION OF CHLORINE AND HYDROGEN WITHOUT EXPLOSION IN PRESENCE OF CONTACT SUBSTANCES—*B. Neumann.*—Calcium, aluminium and magnesium chlorides, after

having been heated to 400° in a current of the gases chlorine and hydrogen, bring about the quantitative union of these gases at 300° to 380°, provided that the rate of the current of gases is not too rapid. Magnesium and calcium chlorides are partly (6 to 8 per cent.) converted into MgOHCl and CaOHCl, while aluminium chloride is almost entirely transformed into Al_2O_3. Quartz can also be used as a contact substance, the temperature of the reaction being 380°. It is absolutely necessary to have enough water present in the mixture of gases so that finally HCl + H_2O may be obtained. Air has no effect upon the reaction, since the temperature is too low for the oxygen to oxidise the hydrochloric acid.—(*Zeit. f. Angew. Chim.* XXXIV., 1921.)

STASITE. A NEW CHEMICAL — *Alfred Schoep.*—Chalcolite obtained from Kasolo (Katanga, Belgian Congo) frequently contains a new mineral, which appears yellow to the naked eye, of density 5.03 at 17° C. Chemically this new substance behaves like dewindtite. When heated in a closed tube it gives off water, and becomes reddish brown, returning to its original colour when cooled. When heated on charcoal in the oxidising flame of the blowpipe, it readily fuses to a black globule, while when heated with sodium carbonate in the reducing flame it gives globules of lead. It dissolves in nitric acid, and the solution gives with molybdic liquid a copious yellow precipitate of ammonium phospho-molybdate. The mineral also dissolves in hydrochloric acid with formation of crystals of lead chloride and in sulphuric acid, giving a precipitate of lead sulphate; these solutions are coloured yellow by uranium. When the mineral is analysed, it is found that its composition corresponds to the formula 4 PbO $8UO_3$ $3P_2O_5$ $12H_2O$, which is the same as that of dewindtite. It differs from the latter in density, colour, the colour of its dust, and its crystalline form. Its radioactivity is slightly less than that of dewindtite. Stasite, the new mineral, and dewindtite are two dimorphous varieties of the same compound.—(*Comptes Rendus*, CLXXIV., No. 13, 1922.)

CATALYTIC DECOMPOSITION OF OLEIC ACID. —*Alphonse Mailhe.*—When vapours of oleic acid are led over copper-aluminium heated in a copper tube to 500°-650° they decompose normally, giving liquid products, water and gas. The latter consists chiefly of hydrocarbons of formula C_nH_{2n+2} and hydrogen, and contains also CH_4, CO, C_nH_{2n+2} and CO_2. The liquid products are acid. When they are treated with dilute soda a yellow product is obtained which begins to distil at 40°. The different fractions get hot when treated with sulphuric acid, which absorbs more than half the liquid. The portion distilling between 40° and 50° gives with bromine amylene dibromide. When the liquid obtained by the decomposition of oleic acid is hydrogenated over nickel, it is transformed into a mixture of aliphatic hydrocarbons and cyclic hydrocarbons, amongst which are benzene, toluene and metaxylene.—(*Comptes Rendus*, CLXXIV., 13, 1922.

PROCEEDINGS AND NOTICES OF SOCIETIES.

"THE POSSIBLE ECONOMIC DEVELOPMENT OF HOME SUPPLIES OF FUEL OIL."

By PROF. J. S. S. BRAME, F.I.C.

(*President of the Institution of Petroleum Technologists*).

The usual monthly meeting of the Section was then held, and Prof. Brame read the above-titled paper.

Prof. Brame, in dealing with the necessity for this country to take into serious consideration the possibility of the development of the home supply of fuel oil, reviewed the published proceedings and findings of the "Crewe" Committee and the Department of Petroleum Research at some length.

Early in 1918, the Institution of Petroleum Technologists appointed a Committee of Inquiry, the terms of reference to which were to obtain evidence in respect of the quantity of cannel coal available in Great Britain as the source of motor spirit, fuel oil, etc., and to formulate a scheme for the utilisation of such supplies. In their conclusions, this Committee stated that the possibility of obtaining oil in quantity from the low temperature distillation of cannel coal and its cognates had been considered from two points of view, namely, as an immediate war measure in respect to mak-

ing provision for the Services, and as a commercial undertaking and measure of reconstruction. Further, the Committee were satisfied that at least 1,200 tons per day of retortable material could be economically assembled for treatment, provided the necessary facilities were given by the Government, and the requisite labour was available, at an average of 30 gallons of oil per ton, thus giving a yield of 300,000 gallons of crude oil daily, or upwards of 400,000 tons a year. Much of the material available had hitherto been mined but not raised, or, if raised, had been consigned to spoil heaps or returned to the underground workings. If the substitution of the shovel for the fork, so strongly demanded by the miners, was made obligatory by the Government, still more material would be sent up, and, under present practice, wasted. An improvement in this state of affairs necessarily depended upon the obtaining of by-products. The residues obtained from a non-caking material high in ash content could be utilised in a prducer for the production of power gas and sulphate of ammonia. The residue obtained from a non-caking coal low in ash content could be utilised for the manufacture of briquettes.

The conditions which existed in wartime, and which probably justified the small attempt made in this country to produce fuel oil, did not exist to-day. The difficulty then was shortage of labour. The problem to-day was shortage of work. Any scheme which appeared to promise a possibility of providing labour for the unemployed, and at the same time be the means of producing valuable and easily marketable commodities like liquid and smokeless fuels, was worthy of serious consideration. In vie of the large power stations which it was proposed should be installed throughout the country in the immediate future, the question of the utilisation of retorted residues for power production became of increased importance.

The world's demand for fuel oil had gone up by leaps and bounds during the past five years. There had been a certain proportionate increase in production, and the Persian Oil Company had now established refineries at Swansea, while another company had established others at Southampton. In 1920 the output of oil was about 97 million tons. There was an importation of four million gallons of crude oil, motor spirit 207 million imperial gallons, lamp oils 161 million gallons, lubricating oils 106 million gallons, gas oil 53½ million gallons, fuel oils 327,771,000 gallons. On the basis of the recommendations of the Committee of Inquiry of the Institution of Petroleum Technologists, 100 million gallons of crude oil could be produced per annum. It must be borne in mind, however, that this oil was not quite the same thing as crude petroleum. A considerable proportion of it would not be suitable for use as fuel oil, as it contained pitch, which would have to be left behind by distillation. Possibly 60 per cent. of the total oil obtained would be suitable as liquid fuel. Another drawback in the case of oils obtained by low temperature distillation was that they were somewhat rich in tar acids, thus detracting considerably from their calorific value. It would not pay to separate out tar acids. Another point was that the oils became a butter-like mass owing to the presence of wax. They, therefore, required cracking.

Prof. Brame then dealt briefly with the position of the Scottish Shale Oil Industry, and mentioned the shale deposits which outcropped in Dorset and Norfolk. In the case of the two latter there was a high sulphur content of from 7 to 8 per cent., which it was extremely difficult to eliminate by chemical treatment.

Dealing with low temperature carbonisation of coal, Prof. Brame referred to the Report of the Nitrogen Products Committee issued in 1918. This Committee pointed out that if the whole of the 35 million tons of domestic coal consumed in this country were substituted by low temperature coke, it would mean that 54 million tons of coal would have to be carbonised. The yield of tar, at 18 gallons per ton, would be 972 million gallons, and of light spirit, counting 2.25 gallons to the ton, would be 121.5 million gallons. He fully believed that the commercial unit for carbonisation at low temperatures had been arrived at in more than one instance. The idea of carbonising coal with the object of obtaining a smokeless fuel was not new; it was discussed as long ago as 1656.

Having indicated the main points of patents taken out for the production of smokeless fuel down to the time of Thomas Parker (1890), the lecturer explained the construction and method of operation of the "Tozer" Patent Retort, the "Chis-

wick" Screw Retort, the "Smith" Plant, and the "L.M.N." System.

The Nitrogen Products Committee stated that there was no commercial practice in this country upon which definite reliable data could be formulated as to costs and average yields, though they published some extremely valuable information relating to low temperature carbonisation with subsequent gasification of coke. The figures given, however, must be accepted with a certain amount of reserve, as the results indicated were those of only two systems, the "Tozer" and the "Chiswick." If a large power plant was taken, such as would be supplied for a station generating 100,000 kw., with a 100 per cent. load factor and an average coke, and the over-all efficiency of a steam plant with direct firing and turbines taken as 100, then the efficiency of low temperature carbonisation was some where between 72 and 75 per cent., but if one took the coke, and subsequently gasified it, and used the gas at 75 per cent. efficiency for raising steam in the boilers, then the efficiency only ran from about 40 to 45 per cent. Taking the question of the ratio of coal consumption, direct coal fire being taken as unit, low temperature carbonisation, followed by the use of coal under the boilers, would require 1.32 to 1.39 lbs. of coal instead of 1.0, and if the coke residue was gasified it would require 2.2 to 2.5 times.

Although there was probably very little Torbanite in this country yet, it contained material which was very rich in oil. Bastard cannels were usually high in ash content, but they were undoubtedly retortable material. Mr. Dunningham Craig considered that there were very few of the remaining cannels which would yield 50 gallons of oil to the ton, but many of them would yield 40. The worst of the bastard cannels would yield something between 20 and 25 gallons, and whether it would pay to retort them depended largely upon the utilisation of the gas which might be obtained from the carbonaceous material left in the residue. A considerable quantity of sulphate of ammonia could be obtained by means of low temperature carbonisation, but of course the bulk of the nitrogen remained in the carbonised residue, and a considerable amount of revenue might be derived from subsequent gasification. There was also a possibility of saving a lot of good coal by means of working, if the "floor," for instance, was capable of distillation after

There was a considerable difference between low temperature tar and high temperaturen tar. One might almost say that the low temperature tar was a kind of intermediate body between petroleum and high temperature tar. It contained a comparatively large quantity of saturated hydrocarbons and a comparatively small quantity of the benzinoid hydrocarbons, and very little free carbon. It did not contain napthalene, though it did contain a large quantity of tar acids which might prove to be a drawback in the use of the oil in internal combustion engines. Steam raising by oil was really unpardonable, except under such circumstances as existed in the navy.

If the oils were used in a raw state, one did not know what the effect of the 30 to 4 0per cent. of pitch material might be, but it would probably be the same as a high asphalting content in a mineral oil. It was easy enough to wash out the acids. American scientists had shown that if coal was distilled under high pressures, with a reflux arrangement fitted to the retort, there was condensation of the higher boiling fractures and dropping down into the retort, and there could be cracking of a larger quantity of the phenolic bodies into lighter spirits. Cannel oils were a different type of material to that obtained from the low temperature tars. The coke from bituminous material was not the same as from cannel and canneloid substances, owing to the presence of paraffin wax. It was a doubtful proposition whether it would pay to extract the paraffin wax, and it had the great disadvantage of establishing a high setting point which might be 30 deg. C.

Low temperature oils sometimes held water in a most persistent way, and in some cases it appeared to be in a perfect state of solution.

A long discussion followed the reading of the paper, and the proceedings concluded with a vote of thanks to Prof. Brame.

THE SOCIETY OF DYERS AND COLOURISTS.

Annual Meeting.

The annual gathering of the Society of Dyers and Colourists took place in Manchester on March 31, and the preliminary proceedings were opened at the College of

Technology. Prof. E. Knecht, Ph.D., M.Sc., presided over a very large meeting.

THE ARTIFICIAL SILK INDUSTRY.

Prof. E. Bronnert, Ph.D., of Strasbourg and Mulhouse, Alsace, France, who is a manufacturer of very large quantities of artificial silk, gave an extremely interesting and instructive address upon the progress made in the artificial silk industry.

Prof. Bronnert said that the history of the artificial silk industry, that is to say the various processes by which it has evolved, is too well known to require further detailed repetition, but perhaps a short resumè, by way of introduction, would not be considered out of place.

The idea of producing practically artificial fibres which might perhaps some day supplant those of the silk worm, is due to Count Hilaire de Chardonnet, who has been called the father of the artificial silk industry. To him we owe the nitro-cellulose process which he published in 1884. This process was the first to be used on an industrial scale, and was prevalent throughout the nineties. The close of the nineteenth century saw the industrial adoption of the cuprammonium process by Bronnert, Fremery, and Urban. Following hard upon these two processes are those of the Viscose and more recently the Viscose improved processes.

The use of artificial silk may be said to be as yet in its infancy, and from day to day fresh uses are discovered for its products. They tend to increase as cheaper processes are evolved. The silk as it was originally manufactured, owing to this factor of cost, has only been able to be used to advantage along with other textile fibres, such as cotton, and in these cases the fibre preponderating has not been artificia lsilk. It is only now that artificial silk alone is being used in the manufacture of articles on a large scale. The present fashion has been of much use to the industry, for it has been possible to use the silk in the manufacture of ties, jumpers, stockings, underclothing, and articles of a similar nature, without the admixture of other fibres.

A new step has been taken in the production of artificial viscose silk. Until now, artificial silk, for a variety of reasons, has only been produced of a count varying from 8 to 10 deniers, while the double thread of the silk worm is of two to three deniers. It has always been a complaint among consumers of artificial silk thread that manufacturers appeared to be unable to place a thread of the fineness of natural silk on the market. A French inventor and artificial silk manufacturer has now supplied this need in a most remarkable manner.

Colloidal solutions of cellulose, like viscose, are spun by the well-known process of forcing them through fine apertures. The apertures were required to be smaller in the case of a fine thread, and larger in the case of a coarse thread. More concentrated solutions of cellulose were required to obtain stronger threads. Concentrated solutions of cellulose, on the other hand, required narrower openings because of their high content of cellulose. However, the difficulty in filtering the solutions in order to prevent a rapid choking and the boring of the apertures, as well as the increased pressure required, are all causes of an irregular spinning, and operated therefore against a higher concentration. Hitherto an average good spinning of 8 deniers has been accomplished, with a solution containing 8 per cent. of cellulose, and with apertures of 0.1 mm. diameter.

The employment of finer apertures occasioned only more difficulties, and among other attempts, one of drawing off rapidly the thread as it was produced and of a less feed of viscose to the nozzles, proved quite unsuccessful. Many were the attempts made to solve this problem of the fine thread.

Now, however, it has been shown that under certain conditions threads of two to three deniers and less may be spun with the greatest regularity and ease. The same size of apertures may still be used, and the same maximum spinning speed of 45 metres per minute may be continued. The two factors of this important improvement are the feed of viscose to each aperture in relation to a unit of time, and a minimum percentage of acid different for each count is necessary in the spinning bath. Below this minimum, spinning of this count is impossible. It is a well-known fact that a rapid exhaustion of the acid spinning bath took place in the case of the former 8 deniers threads, when the flow of the alkaline viscose running through an acid bath had neutralised the acid to a greater or less degree. But until now it has not been known that for each count a special and strictly limited minimum concentration was required, in conjunction with an ap-

propriate feed, and that it was possible to retain the usual nozzle of 0.1 mm. by using, for example, the ordinary viscose as used by ripening the alkaline cellulose first and then the viscose solution itself to a certain degree of maturity.

In this new process for fine spinning, maintaining the minimum concentration for each count is so important that no lower count can be spun with regularity than that of the particular thread for which it is adapted.

There is a certain relation between the counts of the single thread and the concentration of the acid in the spinning bath, and this has been reduced to a rule and named by Prof. Bronnert the "Square Root Law." The square roots of the different counts are inversely proportional to the concentration of the acid in the bath. The minimum concentration for an 8 deniers thread is, as already known, 140 gms. of monohydrated sulphuric acid per litre. For this new spinning process no change need be made in machinery, and the output remains unaltered, and any count may be spun with the apparatus by the mere conforming of conditions according to the square root law.

Brilliancy in the fine counts may be varied at will and without any damage to the strength of them. To reduce brilliancy and to obtain an opaque thread, it is only necessary to lower tempearture, whereas by raising the temperature to 40 or 50 degrees C., a thread of more and more brilliancy is produced. The new viscose has a very soft touch and a much increased covering power, dyes evenly, and when woven does not easily crease.

Methods have been put forward for the recovery of the products in the viscose process. In the cuprammonium process a recovery of about 90 per cent. of the ammonia and 95 per cent. of the copper has been effected without excessive expense. The soda lye in the viscose until now had been wasted, after having been neutralised by the sulphuric acid of the spinning bath. It had been suggested to recover sulphate of sodium from the spinning bath by cooling it, and so causing a dissociation of the bisulphate in the spinning bath into neutral sulphate and sulphuric acid. This method, however, was faulty and most expensive. The fact is that the sulphates produced do not remain in the spinning bath, but are formed only on the threads emerging from it and received on the spools or the like. Threads, as a rule, are only slightly acid when the acid has penetrated the thread and entirely neutralised the alkali of the viscose. In washing with water the process of removing the neutral salt from the inner parts of the threads takes a long time, and much water is required.

The finer threads require a more acid salt bath, and acid and salt have to be added continually. In a new Bronnert process water acidulated with sulphuric acid is employed to such an extent that all sulphate in the threads is converted into the easily soluble bisulphate, which may easily be washed out on the addition of more sulphuric acid.

After using the same restricted quantity of acidulated water twice, an equilibrium is produced between the contents of bisulphate in the threads and that in the liquid. A further washing would not extract more of the salt, and so the threads are squeezed out and the liquid falling from them collected. After concentration to a certain degree the hot strong acid by sulphate of soda is added again to the spinning bath, instead of adding fresh sulphuric acid and neutral sulphate or bisulphate as was formerly done.

This process has proved most economical and gives the best result, when mixed ammonium and sodium salts are used together with the spinning bath.

A spinning bath of pure acid yields threads with an irregular round cross section. The same occurs when acid is in excess over salt in the spinning bath. The section differs completely when the salt is in excess, and produces the form of a star with serrated outlines. If the salt is in great excess, the thread appears to be coagulated more slowly, and takes the form of a bean, the serrated outline being nevertheless maintained. It is caused by a shrinkage which forces the water out of the inner parts of the thread into the surrounding salt solution. It is possible to observe from these characteristic forms which process has been used in the spinning, and it is as well most important for the specific lustre of the thread. The angular bulbs act like prisms to the light and increase or decrease the transparency of the threads. A higher temperature of the spinning bath hastens the plasmolytic process, shrinkage

takes place in a different way, and different effects are produced.

In spinning from ammonium salt with a little acid, threads are produced of a perfect round circumference, and although these may have a slightly less covering power, they are of even transparency and brilliancy, and of the highest tensile strength, which makes them suitable for use in braids and the like.

A great variation has been found in the strengths of even first class artificial silks, especially when dry. This may be caused by the irregularity of the cross sections and to a defective spinning, and may be brought about in the following way. It has been found that the apertnres become choked not only when impurities owing to bad filtering are in suspension in the viscose, but also when the minimum concentration necessary for the special counts does not exist at each aperture. This becomes worse when some of the apertures are choked, the other apertures producing coarser threads owing to the additional feed of viscose. It is most important, therefore, to have the bath circulating and of constant composition and temperature. In the best silk resulting from one kind of viscose, when all the spinning factors are carefully arranged, the filaments all show the same even section. This may be realised in the acid wet spinning process with the greatest ease, and better than in the Chardonnet process when spinning collodion direct into hot air.

The short fibre received fresh impulse by the above described improvements of Prof. Bronnert. It may be spun to any count, and when it is fine may be mixed with chappe to a certain degree, or may be spun alone with a yarn resembling chappe yarn. These yarns at the same weight naturally exhibit a greater volume than the hanks of artificial silk yarn even when they are of the same count. Although the lustre partly disappears during the combing operation articles manufactured from the new mixed or unmixed yarns have a remarkable "feel" and brightness and if possible to be produced at a low price and on a large scale they may prove of great assistance to the textile industry.

Processes have been further cheapened by another Bronnert process. It is a well-known fact that the usual way of drying gelatinous freshly precipitated and washed cellulose threads had to be carried on with extreme care. When the threads were placed too near to the steam pipes or radiators, producing the higher temperature, the threads became brown, and the cellulose was altered, which meant that only relatively low temperatures could be employed, and of course the drying process took much longer. Much room is required, and the cost for fuel is excessive. Until now the drying temperatures employed scarcely exceeded 60 degrees C.

It has been suggested to remove the water which was supposed to be chemically combined with the cellulose by steaming the threads, but this was a very tedious process. It has now been pointed out that the same gelatinous threads, when well washed from the salts and from the acid, may be exposed to hot air up to 140 degrees C., without becoming brown or producing an unevenness in dyeing afterwards, provided that care is taken that the air circulating at any place in the drying chamber maintains an equal velocity so that no warmer or cooler parts, caused by the evaporating water, exist in any section of the drying chamber.

It makes no difference if the temperature is not the same from one cross section to another, which may quite easily happen when the hot air becomes more and more saturated with water, and consequently cooled, but it is the usual practice to keep the air at the same temperature as when admitted, by reheating it from time to time in its passage through the drying apparatus.

The escaping air at the end of the process is practically at the same temperature at which it entered, and contains the maximum amount of water which is compatible for complete drying. It must be obvious to anyone knowing the great dissolving power of air, which becomes the more so with an increasing temperature, what a great economy of fuel must take place when less air at a higher temperature requires heating for a relatively short time in the drying process.

These improvements are of special significance for short fibre, which must be produced at a low cost on a very large scale if a constant market is to be created.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next Meeting of the Society will be held on Wednesday, May 3rd, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following Papers will be read:—

"Studies in the Titration of Acids and Bases," by J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

"Graphites and other Pencil Pigments," by *C. Ainsworth Mitchell, M.A., F.I.C.*

"The Sulphuric Acid Reaction for Liver Oils and its Significance," by J. C. Drummond, D.Sc., F.I.C.

"Inadequacy of 'A.R.' Test for Alkalies in Calcium Carbonate," by W. Singleton and H. Williams.

GENERAL NOTES

OPPAU EXPLOSION.

The greatest explosion in history occurred on the 21st September, 1921, at the works of the 'Badische Anilin und Soda Fabrik,'' at Oppau, near Mannheim, Germany. The reports, so far to hand, show that the explosion occurred at 7.30 a.m., and the casualties were given as 600 killed, and from 400 to 500 injured. *The crater formed by the explosion was 135* metres in diameter, and 35 metres deep. The explosion took place in a silo containing *4,500 tons of a double salt of ammonium* nitrate and ammonium sulphate. This sets hard at the bottom of the silo, and it was the practice to blast it out, using an ammonium-nitrate explosive and detonators. Although this had been going on for a considerable period and many thousand shots had been fired without accident, it has been suggested that this was the cause of the explosion.

THE STRUCTURE OF THE ATOM.

Under the above title, D. Stephen Maill, B.Sc., LL.D., has produced an interesting little booklet dealing in an original manner with the progress of events that have led up to our present conception of Atomic Structure.

The "story," for that, more than anything else, is the character of the brochure, commences with the discovery of the inert gases of the atmosphere, and gives details of the early work of *Lord Rayleigh* and Ramsay. The discovery of X-rays, Becquerel's discovery of the radioactivity of *Uranium*, and the subsequent work of professor and Madame Curie; the work of Rutherford, Soddy, Moseley, Bragg, Langmuir, and others—is given briefly and with great accuracy.

The whole brochure is an exceedingly readable little production, and we can confidently recommend its wide distribution.

Publishers: Messrs. Benn Bros., 8. Bouverie Street E.C.4; price 1/6.

THE ATOMIC WEIGHT OF YTTRIUM.

An account is given in the Journal of the American Chemical Society of an exhaustive research by H. C. Fogg and C. James, to determine the atomic weight of Yttrium, *the mean of twenty-one experiments gives* 89.03. Clèves value was 89.12, and many other workers have found values not far removed from this.

OPIUM CULTIVATION.

In the House of Commons last week, Earl Winterton, the Under-Secretary for India, informed Mr. Gilbert that the area under poppy cultivation in British India was 177,124 acres in 1918-1919; 163,125 acres in 1919-1920; and was estimated at 143,750 acres for the year 1920-1921. The area *under cultivation in the Indian States had* been estimated at 24,871 acres in 1918-1919, and 56,934 in 1919-1920. In neither case were *total figures available for any later* period. The total amount of raw opium produced from the area under cultivation in British India was 2,247,061 lbs. in 1918-1919; 1,876,114 lbs. in 1919-1920; and was estimated at 1,645,714 lbs. in 1920-1921. No information was available regarding the total production of the Indian States. The amount of raw opium exported from British India was 14,828 chests in 1918-1919, and 10,509 in 1919-1920. The gross revenue derived by the Central Government from opium was £3,289,111 in 1918-1919: £3,037,480 in 1919-1920; and was estimated at *£2,415,466 in 1920-1921.*

IMPORTATION OF DYESTUFFS.

Mr. Kiley asked the President of the Board of Trade if his attention had been called to the resolution passed at a meeting of chemical merchants and users, at a *meeting* in London on 4th April, affirming that the Dyestuffs (Import Regulation) Act and the Safeguarding of Industries Act had

not only failed to achieve the results the promoters anticipated, but had caused grievous inconvenience, great uncertainty, vexatious delays, and much loss of time, money, and prestige, and, as the continuance of these Acts threatened to jeopardise and divert trade vital to national interests and increase rather than lessen unemployment, the early repeal of both Acts was demanded; and, if so, what action he proposed to take.

Mr. Baldwin said: I understand that a resolution to the effect stated by the hon. member was recently passed by a body called the Chemical Merchants' and Users' National Vigilance Committee, but as I do not accept any of the propositions laid down in the resolution, I do not propose to take any action in the matter.

Mr. Lyle-Samuel asked the President of the Board of Trade what was the total value of reparation dyes received from the Germans during the year 1920-21 and the value realised; whether all these dyes were sold through the medium of the central importing agency; and what was the amount of commission and expenses allowed to this organisation.

Mr. Baldwin replied: I am unable to state separately the value of Reparation Dyes received from the Germans during the year 1920-21, but the total value of Reparation Dyes received from Dec., 1919, to March 31, 1921, was £549,094, and the amount realised from sales during that period was £380,062. The dyes were all sold through the Central Importing Agency, who were paid a commission, to include expenses, of 3½ per cent. on the amount realised.

NOTES ON BOOKS.

Elementary Chemical Microscopy, by EMILE MONNIN CHAMOT, B.Sc., PH.D. Second Edition, partly re-written and enlarged. John Wylie & Sons, New York. Chapman & Hall, Ltd., 11, Henrietta St., Covent Garden, London. Price 25/- net.

The author states in his preface that in the six years which have elapsed since the appearance of the first edition, the great majority of American chemists have come to regard the microscope as a necessary adjunct to the laboratory.

The first eight chapters are chiefly occupied with the microscope and its accessories, and Chapter 8 commences a course of practical work in quantitive analysis, determinations, melting points, refractive index, and other important matters. Throughout the whole work details are given of special experiments to be carried out by the student, making the work—as the author suggests in his preface—a textbook rather than a book of reference.

The value of a microscope as a means of investigation is becoming recognised rapidly as an aid in research not only in the chemical but in almost all other industries. The work in question will be found of real value in the research laboratory, as it deals with all the latest developments in the science of microscopy. The book is very fully illustrated, and is intended to serve as an introduction to the microscope and its accessories regared as tools to work with.

A promise is given of a handbook of microscopic qualitative analysis, designed for the use of advanced students and professional chemists, which is in preparation. To those who have mastered the contents of the book under notice, such a work will be found of great value.

DEPARTMENT OF OVERSEAS TRADE.

22nd April, 1922.

His Majesty's Consul-General at New Orleans (Major C. Braithwaite Wallis) reports that an American firm of wholesale druggists are desirous of purchasing the undermentioned materials in the United Kingdom:—

500 barrels naphthaline balls and flakes.
5 bales Tinne Velly senna.
5 casks potassium permanganate.
1 cask sugar of lead acetate crystal.
1 cask potassium prussiate yellow.
5,000 lbs. acid carbolic white crystals.
1 lb. bottles and 5 lb. tins inclusive.

Quotations should include c.i.f. New Orleans, privilege of examination and cash against documents.

The name and address of the firm referred to may be obtained by United Kingdom manufacturers and exporters interested on application to this Department.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

9060—Adam, E. B.—Production of red basic dyestuffs. March 29.

9316—Colman, H. G.—Treatment of hydrocarbons. March 31st.

9189—Law, H. D.—Formaldehyde-producing apparatus. March 30.

9323—Schmidt, A.—Chlorination of cellulose lyes. March 31.

9366—Techno-Chemical Laboratories, Ltd.—Continuous filtering apparatus. March 31.

Specifications Published this Week.

176834—Woodall, Duckham & Jones (1920), Ltd., and Sir A. M. Duckham.—Furnaces for producing chemical changes.

153917—Merck, E. (firm of), and Wolfes, O. Preparation of tropinone mono-carboxylic acid esters.

176864—Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd., and Morgan, J. S.—Method and apparatus for producing chemical reactions by action of heat.

176924—Shimadzu, G.—Lead oxides and the process to manufacture the same.

176925—Segaller, D., Peacock, D. H., and British Dyestuffs Corporation, Ltd.—Manufacture of oxy and sulpho-oxy derivatives of anthraquinone.

156215—Chemische Fabriken Worms Akt-Ges.—Manufacture of amthraquinone and its derivatives.

Abstract Published this Week.

Aluminium chloride.—Patent No. 175,006.—A process of producing aluminium chloride has been invented by Mr. E. R. Wolcott, of 917, Crenshaw Boulevard, Los Angeles, California, U.S.A. A mixture containing aluminium silicate and carbonaceous material is heated to drive off hydrocarbons, and is then further heated in the presence of a chloridizing-agent to distil off the aluminium chloride. Preferably, a naturally occurring mixture such as ore or bituminous shale or low-grade slaty coal is used, but the desired mixture may be made by grinding argillaceous material with low-grade petroleum, petroleum residues, peat, &c. The fuel-residue from any furnace which does not effect the complete combustion of the carbon with the addition of carbonaceous material, shale, &c., to make the mixture of the right composition may also be employed.

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PATENTS AND DESIGNS ACTS, 1907 AND 1919.

PHENOL PRODUCTS.

THE PROPRIETOR of British Letters Patent No. 9291, of 1914, is prepared to sell the Patent or to license British Manufacturers to work under it. It relates to an improved method of manufacturing condensation products of phenol and substances containing the methylene radical.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3238.

THE BRITISH GLASS INDUSTRY.

On the retirement of Dr. Morris Travers, F.R.S., from the Presidency of the Society of Glass Technology, Professor W. E. S. Turner, D.Sc., of Sheffield University, was unanimously elected for the ensuing year.

In his presidential address, entitled "The British Glass Industry: its Development and Outlook," Prof. Turner outlined some of the work he hoped the Council would be able to do during the forthcoming year, and included in his survey the revising and re-issuing of standard specifications for certain glass furnace refractory materials. He hoped it would also be possible to consider the formulation of specifications for some of the more important glassmaking materials, and the setting up of standard tests for glass itself.

Prof. Turner then gave a very comprehensive account of the growth of the British glass industry from the time of the Roman occupation to the present day. Speaking generally, there was a steady growth up to the year 1875, after which time the number of glass factories began to decrease and the imports of finished glassware increased. This steady decline was arrested on the outbreak of war in 1914, and during the last few months of 1914 and 1915 there was an infusion of new blood and the industry was revived. Certain new branches of the industry had under the stress of war to be created—the production of chemical glassware had to be undertaken, and the building up of a lampworking industry had to be begun. These new branches of the industry grew to such an extent that during the last twelve months of the war period more than two million pieces of chemical glassware were made at the furnace, more than 39 million lampblown articles were made, and more than a million pounds of glass rod and tubing were drawn. During this same period the output of electric lamp bulbs was in excess of 43 millions, while in pre-war years the output was not more than 4 million bulbs.

Turning to the future, Prof. Turner acknowledged that the immediate outlook was not cheerful, but claimed that the industry was much more efficiently equipped than at any other time in its history, and provided that politicians could settle the problem of international exchanges before it was too late, they might look forward to a prosperous future. There was plenty of scope for new developments in the industry, and many novel uses to which glass may be put, so that there was no need to lose confidence in the industry.

The Very Reverend W. Foxley Norris, D.D., Dean of York, gave an interesting address on the Mediæval glass of York Minster. He pointed out that the windows of York Minster were the finest samples of the 13th and 14th century English stained glass that it was possible to find, and they were literally a priceless possession. Unfortunately the glass was showing signs of decay, and in some cases the deterioration was very pronounced. The work of cleaning the windows and releading them was proceeding, and they were also trying various means of preserving the glass itself from further decay.

A SENSITIVE TEST FOR PHENOLS.

By James Moir, M.A., D.Sc., F.I.C.

(*Read 19th September*, 1921.)

(*Reprinted from the Journal of the South African Chemical Institute*, January, 1922.)

For phenols as such—i e, not in solution, the best test is undoubtedly the distinctive colour of the phthaleins produced when the specimen is gently warmed with a trace of *p*-oxybenzoylbenzoic acid and a drop of sulphuric acid, and the result dissolved in ammonia (see Moir, *Trans. Royal Soc., S.A.*, 1918, 112; also Orndorff & Murray, *J. Amer, C.S.*, April, 1917).

It is well-known, however, that the ordinary tests for phenols break down if the reaction of the fluid to be tested is either markedly acid or markedly alkaline. The ferric chloride coloration for example can in practice only be obtained with a pure aqueous distillate containing nothing but phenol and water. Similarly tribromophenol is not characteristic, except in smell, unless perfectly pure. The mercury test and the chlorofor mtest do not apply to dilute solutions.

Having had occasion to detect phenol in soap, in which the proportion of phenol was not more than 0.01 p.c., I devised the following process. which can be carried out if necessary on the original without distillation. The reagent is paranitraniline hydro-

gen and hydrogen mixture, the anhydride of formic acid, viz., carbon monoxide, is added, then, when saturated with water vapour, the mixed gases should react in chloride, and is made up in the same way as "Reagent A" of my test for nitrous fumes (This J. IV., January, 1921, foot of page 5), viz., 1.5 grams paranitraniline base dissolved in 500 cc. of hot water with the aid of about 40 cc. of strong hydrochloric acid.

"BROMINE,"

And Its Commercial Importance.

By John Missenden, B.Sc.

Bromine is a liquid element of the halogen group, and was first discovered in 1826, but was not produced in such quantities as to be of commercial importance until 1860.

Originally, it was discovered by Balard of Montpelier in the mother liquor obtained after the crystallisation of salt from sea-water to the extent of 10.5 grains in each ten gallons, and he succeeded in isolating it in very minute quantities. Later, it was discovered more abundantly in saline springs, particularly in those at Kreuznach and Kissingen, in Germany, but even with this discovery it did not become greatly applied to the cause of Science.

The most important source at the present time is the potash beds at Strassfurt, it being present in the mother liquor to the extent of 0.27 per cent. Here it is usually found in chemical conjunction with magnesium to form magnesium bromide ($MgBr_2$). The magnesium bromide is extracted from the crude carnalite which forms part of the potash deposits, and the pure bromine is separated from the magnesium by bringing the compound into contact with separately generated chlorine, the magnesium having a greater affinity for the chlorine than it has for the bromine.

More recently, an electrolytic process has been tried, and has been successful. It has been found that, when both magnesium and chlorine are found with the bromine (as, indeed, they often are), all the bromine is liberated before the chlorine.

Bromine is a deep red liquid, having a density of 3 at 17.8° C., and it readily evolves red fumes, which are extremely destructive to animal tissue. Its name is derived from its irritating and suffocating odour by the word βρομοσ, meaning a "stench." It is scarcely soluble in water, but is slightly more soluble in alcohol and ether. The weak solution that is produced by mixing it with water has very valuable bleaching properties. Its boiling point is 63.2° C., and it freezes to a red crystalline solid at -12.5° C.

Bromic acid, $HBrO_3$, is monobasic, and is perhaps the most familiar of the bromine compounds. It is produced in its free state by the action of silver bromate, $AgBrO_3$, on pure bromine, forming silver bromide, AgBr, and bromic acid. It is responsible for a somewhat extensive series of bromates, the majority of which are of no commercial value.

Potassium bromide, KBr, is prepared by the action of bromine on potassium hydrate, KOH, the hydroxyl group being driven off. It is greatly used as a medicine for nervous diseases, such as delirium tremens, sleeplessness, epilepsy, hysteria, and in other complaints where a depression of the nervous system is desirable. Because of this valuable property, many people are inclined to use it to excess in order to still nervous excitability. This use—or, rather, abuse—of the medicinal properties of potassium bromide is the cause of a complaint known as "bromism," the symptoms of which are skin eruptions and growing muscular and sexual weakness. Those who indulge in the taking of this drug are familiarly known as "Bromides," but their internal lassitude soon disappears when they cease to take the substance. The excessive use of potassium bromide has been responsible for many evils, and, in certain sections of society, has led to an unhealthy state of mind which makes it a considerable danger.

In photography, a 10 per cent. solution is very efficacious in retarding the action of a developer, and is known as a "restrainer."

Bromoform (or tribromomethane) $CHBr_3$, is a clear, heavy liquid analagous to chloroform, and was first discovered by Lowig in 1832, but its true nature was discovered by Dumas. It is mostly used for separating and determining densities in mineralogical processes, and is also used to a slight extent in medicine.

Silver bromide, AgBr, is mostly familiar in connection with photography, it being sensitive to light, and forming what are known as "bromide prints." The printing paper is coated with an emulsion of silver bromide in gelatine, with or without other

silver halloids, and is used for obtaining *prints by development* either by contact printing or by enlarging with day or artificial light.

There are other bromides, such as *sodium*, *antimony*, and *lithium*, but they are little in demand, being of small or no *commercial value*.

INTERNATIONAL ECONOMIC IMPORTANCE OF PRECIOUS STONES IN TIMES OF WAR & REVOLUTION.

By Dr. George F. Kunz,

President, American Scenic and Historic Preservation Society.

(Reprinted from "The Scientific Monthly," March, 1921).

Almost from time immemorial, gold and silver have been acknowledged as the standard precious metals. For twenty-five centuries they have been used in coinage, varying from gold at eight times to forty-five times the value of silver and now receding to about fifteen times. Up to the present time seventeen billion dollars' worth of gold has been mined, of which five billion has been lost, leaving twelve in circulation and in the arts. There are now in the governmental treasuries or in banks, approximately nine billion dollars' worth. Frequently treasures of gold are found in earthen or leaden pots, dating from five centuries before Christ to the Christian Era, which are absolutely perfect and as intact as the moment they arrived from the mint.

Although at various times in various parts of the world, corn, rice, rock salt, cocoanuts, dates, shells, whale's teeth and wampun have been used as a medium of exchange, they only had a local value and were not international. The paper moneys of the world have little durability, and there is scarcely a paper note known that has held its value for more than a century. Even our own Colonial bills, and bills of the Confederate States have no value other than to an antiquarian. Of all known metals, nothing possesses the compactness in value, the rarity, the richness and the convertability in every capital of the world, of precious stones, whereas 100 ounces of gold would be as much as any individual could comfortably carry about with him, approximately $2,000 worth.

Precious stones in all times have been prized as the only objects that can be transported in great value with the least possible bulk. Many precious stones have such value that a million dollars' worth do not weigh more than a few ounces to a few pounds, and in the great World War and the aftermath of the War, in Russia and other European countries, these were hurriedly bought, and there are many instances on record in which they were the only objects that it was possible for the owner to flee with, sometimes at only half an hour's notice, and, as they have no international mark, as would a coin or a banknote, they could be converted in any country to which a refugee departed.

In regard to paper moneys, with the exception of the money of the United States, all other issues have depreciated over 10 per cent., or, in some instances, as in Austria and Russia, have fallen to only 1 per cent. of the original value; and as precious stones exist to the value of $3,000,000,000, this is a large enough value to have an economic importance in times o fwar and stress. As to permanency of value, the Regent Diamond, sold to France in the time of Louis XV., to-day, after changes from kingdom to republic, consulate and empire, and again to republic, is itself unchanged and as precious as the day it was bought in its rough state by Thomas to procure funds indispensable to the consolidation of his power. History tells us Pitt, in the early eighteenth century. Bonaparte pledged it to the Dutch Government how the great diamond of Charles the Bold was placed as a loan with the Fuggers of Augsburg, the great money-lenders of the fifteenth and sixteenth centuries, or by the inhabitants of India before money could be placed at interest, as forming the only absolutely transferrable international medium of exchange.

About 6,000,000 ounces of platinum have been found, worth about $80 per ounce, approximately $500,000,000, of which two-thirds has been used by dentists and chemists. Therefore it would not be a factor in world values; and is not so easily understood or recognised as is gold or silver.

Preciousness consists of indestructibility, rarity, portability and convertibility. Thus, gold is one of the most important of the precious metals. Alexander the Great, in his time realised that by transporting gold to India, instead of silver, his camels

carried thirteen times as much in value. At that time the ratio was about thirteen to one.

The Sultana of Sulu owned a necklace of beautiful pearls. When visitors tried to buy them, she said, "Why should I sell them?" They said, "We will give you moneyfor them." She said, "What can I do with the money? If the enemy comes, it is too heavy to flee with. My pearls I could take with me, and if I need money I can always sell a pearl." The Sultana realised the portability and value of pearls

PLATINUM.

By George F. Kunz.

(Continued from Last Week).

Platinum Metals in Foreign Countries.

Australia.—In Tasmania, while platinum deposits have not yet been discovered, although a little of the metal has been secured in the refining of blister copper, osmiridium deposits of some importance have been found on the Savage River (Bald Hills) and Wilson River, in the north-western part of the islan. Here it appears in areas of serpentine, in the form of nuggets and fine grains in alluvial deposits, with magnetite and chromite, and close to the boundary of sedimentary rocks and the intrusive serpentine. Regarding these osmiridium deposits, Mr. A. 1. Reid, Assistant Government Geologist of Tasmania, gives the following information: [1]

"The occurrence of bronzite, ensatite, and olivine in peridotites, pyroxenites, and gabbros—or in serpentine resulting from the decomposition of these rocks—is considered to be favourable for the presence of osmiridium, while monoclinic pyroxenes, such as augite and diallage, appear to be limited to rocks barren of osmiridium. The deposits containing osmiridium are almost exclusively confined to differentiation streaks, or 'schlieren,' in structural planes developed in the rock, and not only is it possible to distinguish the osmiridium-bearing serpentines from those that are barren, but the precise location of the deposits in these rocks can be fixed without difficulty. Other interesting features are the presence of chrome spinel in the serpentines and the high percentage of alumina in bronzite."

The osmiridium output of Tasmania has fluctuated considerably since 1910, when the local government began to take official cognizance of it, and when 120oz. of the precious metal was produced. By 1912, the output had risen to 778 oz., and in 1913 it was 1,261 oz. Although mining was partially checked in 1914 by the outbreak of the war, 1,018 oz. were recorded for that year. Then came the poor years 1915 with 247 oz., 1916 with but 222 oz., and 1917 with 332 oz. In 1918 the demand for the metal for war munitions sent the production up to 1,606 oz., and in 1919 the output was 1,669½ oz A curious circumstance is reported concerning the osmiridium deposit on the brow of Bald Head, in the Savage River district, facing Nineteen Mile Creek, for the official bulletin states that here a miner has been quarrying solid serpentine rock for over 6 years, and has secured high-grade osmiridiu mby crushing this rock. The assertion is made that he is the first and only miner in the world to find the metal actually occurring in the solid rock. [1]

The 1920 output was the largest yet recorded, amounting to 2,009 oz., valued at £77,114.

Regarding the sources of the platinum and associate minerals found in the black sands at certain localities of Australia, such as Ballina, near the mouth of the Richmond River, Evan's Head further to the south, and Currumbin, near the mouth of the Twedd River, northward of the locality just mentioned, Mr. Dunstan, Chief Government Geologist, admits that in the case of the associated minerals the source is problematical, but he considers that the platinum and osmiridium were probably derived from the serpentine area, which forms in part the western edge of the Clarence coal measures. He further states: [2]

"Possibly in former times the platinum and other minerals, each from their individual source, were accumulated in the sediment forming the Clarence series of rocks, and which natural agencies are now redistributing in the coastal sands. Along this coast the disposition of sand is nor-

[1] *Cited by B. Dunstan in Queens. Govt. Min. Jour.*, Jan., 1921, p. 20.

[1] *Min. Sci. Press*, Aug. 14, 1920.

[2] *Queens. Govt. Min. Jour.*, Jan., 1921, p. 20.

therly from the rivers bringing the material down from the high lands, and this suggests the idea that the sources of the minerals are always south of the beach deposits in which they happen to occur. Some of the Currumbin sands, indeed, have been found to contain chromite, which rather indicates the serpentine to be the source of some of the minerals contained in them."

"At Ballina and Evan's Head the platinum is the predominating mineral in the sands, with gold in small quantities, while at Currumbin, further north—and further from its source—the platinum is only in traces, with the gold in greater quantities. In California and Oregon, platinum is found in the beach sands of the Pacific Coast and evidently under similar conditions to those at Ballina and Currumbin."

Canada.—While the Canadian production of platinum metals has increased somewhat in recent years, it is still far below what might be expected. The International Nickel Co. of Canada, in the refinery at Port Colborne, Ont., reports a recovery in 1920 of 88.7 oz. of platinum in an impure state, besides 173.8 oz. of palladium, and 19.6 oz. of rhodium, ruthenium, osmium, and iridium. At the New Jersey refining plant of this company, where the recoveries are believed to be mainly if not exclusively from Sudbury, Ont., matte, there were secured 488.9 oz. of platinum; 739.2 oz. of palladium; 309.3 oz. of rhodium, and 102.4 oz. distributed among the platinum metals, osmium, iridium, and ruthenium. In the refinery of the British America Nickel Corporation at Deschenes, Que., the residues from the refining operations are being stored for future treatment.

There should be added to the quantities mentioned a platinum production of 17 crude oz. in 1920 from alluvial sands, even less than the 25 oz. recovered from the sands in 1919. The Canadian exports of platinum in 1920 were 473 oz. of ore, concentrates, etc., valued at £53,956, and 317 oz. of "scrap" platinum, valued at $31,784.[1]

It is asserted that platinum deposits of breat value can be derived from the Fraser River, British Columbia, and from three of its tributaries, the Quesnal, Mellon, and Cottonwood rivers. The statement is made that for a stretch of 250 miles along the Fraser, and for about 150 miles on each of the three tributaries, as much as 75 per cent. of the black sands can be profitably worked. Tests are said to show that the sands yield from 8 to 40 lb. of concentrates per cubic yard. The value of these concentrates varies greatly, ranging from $40 up to $1,200 per ton. Besides platinum, they contain iridium and osmium; there are also smaller quantities of the other platinum metals, palladium, ruthenium and rhodium. The Cariboo Gold and Platinum Reduction Co. has established a plant, and was prepared to begin active operations in the spring of 1921. Should the expectations be realised, British Colombia should furnish a considerable amount of platinum and of the other platinum metals.

Chile.—The black sands on the coast of the Island Chiloe, which belongs to Chile, have lately been proved to hold a considerable quantity of platinum in addition to the gold they contain. The deposits are due to the erosive action of the waves, and the eroded material has been concentrated by the movement of the sea. The amounts of black sands vary notably, constituting as much as 50 per cent. of the deposit at some places, while at others there is but a trace. The concentrates are usually secured near to the present high-water mark. Platinum is found in appreciable quantities only from Tablacura beach and southward, the richest deposits being those of Lavaderos beach. This is near the extreme south-western point o fthe island, immediately south of the Zorras River. This beach is of inconsiderable extent, having a length of only about 25 metres at high tide, but the richest concentrates occur in a strip 25 metres wide between high and low tide. The platiniferous sand averages from 10 to 20 cm. in thickness, and lies over a false bed-rock of clay, and beneath an overburden of 50 cm. of light-gray beach sand; there is said to be a second layer of platiniferous sand beneath the bed-rock. An examination of samples taken at random indicates from 1½ to 2 gm. of platinum per cubic metre. It occurs in thin flaky scales, and is in a free state; there is an iridium content of about 10 per cent. An attempt is being made to exploit the sands by means of a dragline operated by steam, and having a daily capacity of some 20 cubic metres. After screening, the sands are to be passed over amalgamating plates to re-

[1]Prelim. Rept. Min. Prod. of Canada, 1920, Can. Dept. of Mines.

move the gold, and they are then to be concentrated on stationary canvas and burlap tables, to secure the platinum. The plant has been so recently installed that no data as to results are yet to be had. [1]

The island of Chiloe, where these platinum gravels have been found, is about 100 miles long, and averages some 30 miles in width. It is divided from the mainland of Chiloe by the Chacao Channel, and is bounded on the east by the gulfs of Ancud and Corcovado, which constitute the northern end of the inside waterway to the Strait of Magellan. Small freight steamers, of almost 50-ton register, run between the island and Puerto Montt, the southern terminal of the Chilean Government railway. The time required for the journey from Ancud on the island to Puerto Montt is from 8 to 9 hours, and the railway trip thence to Santiago takes about 24 hours.

Colombia.—The two great platinum-bearing rivers in Colombia are the Atrato and the San Juan. Of these, the former, which empties into the Gulf of Darien, is about 300 miles long, is navigable by steamers for two-thirds of its course, and discharges an immense volume of water during and immediately after the rainy season. Although the bars at the river's mouth are only from 5 to 6ft. below the water's surface, the channel is from 750 to 1,000 ft. wide, and has a depth of from 40 to 70 ft. for 100 miles; even at Quibdo, which is 220 miles inland, the river is from 8 to 20 ft. deep and 850 ft. in width. The navigable stretch for steamers reaches some 30 miles farther up, to the confluence of the San Pablo and Certigui rivers. The San Juan is not quite so long as the Atrato, but to its 245 miles should be added the length of a number of affluents, and with these we can count nearly 300 miles of water open to navigation, though only for 140 miles by steamers. It has a width of from 300 to 1,200 ft., and discharges into the Pacific 50,000 cu. ft. of water per second, which is a greater volume than is discharged into the Pacific by any other of the South American rivers. Another great source of Colombian platinum is the region of the Condoto River, but this has not yet been thoroughly explored, so that nothing

[1] Fritz Mella, "Black-sand Deposits of the Island of Chiloe," *Eng. Min. Jour.*, Mar. 19, 1921.

approaching an exact estimate can be made of its productivity[1]

It is becoming more and more generally recognised that the $25,000,000 indemnity to be paid by the United States to Colombia will be made to contribute to the prosperity of the nation according it. For this money, as well as loans for which it will serve as a basis, will be expended in developing the great natural resources of Colombia, not the least of which is its platinum, and the greater the production of this extremely useful metal, the greater will be the quantity available for export to the United States. This will supplement the efforts already being successfully made by capitalists of the United States to increase the platinum output from Colombia's alluvial deposits.

[1] J. Ovalle, "Platinum in Colombia," *Eng. Min. Jour.*, Nov. 6, 1920.

(To be Continued.)

PROCEEDINGS AND NOTICES OF SOCIETIES.

ABSTRACTS OF THE PROCEEDINGS OF THE GEOLOGICAL SOCIETY OF LONDON.

April 12th, 1922.

Prof. A. C. Seward, Sc.D., F.R.S., President, and afterwards Dr. H. H. Thomas, V.P.G.S., in the Chair.

The following communications were read:—

1. "*Oligocene Mosquitoes in the British Museum, with a Summary of our present Knowledge concerning Fossil Culicidæ,*" *by F. W. Edwards, B.A.) Communicated by the Secretary.)*

The material dealt with in this paper is in part the property of the Geological Department of the British Museum, and in part belongs to Mr. R. W. Hooley, F.G.S. The study of it was undertaken by the author at the suggestion of Prof. T. D. A. Cockerell, and by permission of the Keeper of the Department. All the specimens are from the Oligocene of the Isle of Wight.

The result of the study confirms what was already known of the Oligocene Insect-fauna. The genera appear to be inseparable from those living at the present day, and the indications supplied by some of

the species suggest a fauna similar to that of the Ethiopian and Oriental regions at the present day.

No light is thrown by the fossils on the phylogenetic history of the Culicidæ, nearly all the recent types being represented in the Oligocene fauna, and no peculiar forms occurring. The genus *Anopheles*, however, has not been found, probably because of its comparative rarity.

The three species described from the Oligocene of the Isle of Wight by Prof. Cockerell are discussed in detail, and are referred to the genus *Aedes* in the broad sense. Two new species, one of *Culex* and one of *Tæniorhynchus*, are described.

A critical summary is given of our present knowledge of fossil Culicidæ. No fossil that can be positively referred to this family is yet known from the Mesozoic.

2. "*On a Collection of Carboniferous Plants from Peru,*" *by Albert Charles Seward, Sc.D., F.R.S., Pres.G.S.*

The plants described by the author were collected by Mr. J. A. Douglas in 1911 from coal-bearing strata on the south side of the Peninsula of Paracas, a few miles south of Pisco on the coast of Peru. Although the specimens are few in number and for the greater part fragmentary, they are of considerable interest: they demonstrate the occurrence on the coast of Peru of Carboniferous strata; whether the plants should be referred to an Upper or a Lower horizon is not certain. Hitherto no fossiliferous Palæozoic rocks have been recorded from the Peruvian coast.

3. "*The Geological History of the Genus Stratiotes: an Account of the Evolutionary Changes which have occurred within the Genus during the Tertiary and Quaternary Eras,*" *by Miss Marjorie Elizabeth Jane Chandler. (Communicated by Mrs. E. M. Reid, B.Sc., F.L.S., F.G.S.)*

Stratiotes, a monotypic genus of European and West Asian water-plants, is the descendant of a line of ancestors which can be traced back to the Eocene. The seeds have long been known in the fossil state as *Folliculites*, *Paradoxocarpus*, etc., but their relationship with *Stratiotes* was not recognised until 1896. For many years the subject was in hopeless confusion, because the species were ill-defined and the types and type-localities lost or inadequately studied.

The recent seed is first investigated, and an account then given of the modifications which have occurred in the genus since the Eocene Period. Nine species are described or redefined, of which S. Aloides alone is still living. Seven of them appear to constitute links in an evolutionary chain which terminates in the recent plant, while two perhaps represent a branch-line of evolution, distinguished by certain peculiarities of form and raphe.

As the fossil species occur in great abundance, and as several of them are widespread geographically, while each seems to have a limited range in time, there is a hope that Stratiotes may prove of value in the correlation of isolated freshwater deposits in Europe.

The next meeting of the Society will be held on Wednesday, May 10th, 1922, at 5.30 p.m., when the following communications will be read:—

1. "*The Lower Carboniferous Succession in the Settle District and along the Line of the Craven Faults,*" *by Prof. E. J. Garwood, Sc.D., F.R.S., and Miss E. Goodyear, B.Sc., F.G.S.*

2. "*The Miocene of Ceylon,*" *by E. J. Wayland, Assoc. R.C.S., F.G.S., and Dr. A. Morley Davies, Assoc. R.C.S., F.G.S.*

The meeting to commemorate the 75th anniversary of the foundation of the Association des Ingenieurs de Liége will be held during the week commencing Sunday, 18th June. Details of the proceedings will be published shortly.

At the Forty-Fourth Annual General Meeting of the Institute of Chemistry, the Meldola Medal was presented to Dr. Christopher Kelk Ingold, in recognition of his work on the structure of Carbon Compounds. After the presentation, the President's address, which appears in this issue, was given.

ROYAL INSTITUTION OF GREAT BRITAIN.

On Saturday, May 6th, at 3 o'clock, Professor D. H. MacGregor, M.A., M.C., on "Industrial Relationships": (II.), "The Problem of Structure."

THE INSTITUTE OF METALS.

Westminster, S.W.1, April 25, 1922.

Transmutation of the Elements.—Sir Ernest Rutherford, F.R.S., who has recently been elected President of the British Association, delivered the twelfth annual May Lecture before the Institute of Metals at 8 p.m. on Wednesday, May 3rd. The work which has lately been done concerning the transmutation of elements lends especial interest to the discourse, the subject of which was "The Relation of the Elements."

Swansea Meeting of the Institute of Metals.—The annual autumn meeting of the Institute of Metals will be held at Swansea on September 20-22. A ballot for the election of Members and Students desirous of participating in this and other meetings of the Institute will take place on July 13. Membership particulars can be obtained from the Secretary of the Institute of Metals, 38, Victoria St., S.W.1.

Corrosion of Condenser Tubes. — A second and revised edition has just been issued by the Corrosion Research Committee, 36, Victoria St., S.W.1, of the valuable pamphlet entitled " Notes on the Corrosion and Protection of Condenser Tubes." The document, which is published at 2s. 8d. post free, is intended to be of service to manufacturers of tubes and condensing plant, and to the engineers who use them. It is of an essentially practical character, and embodies the results of ten years' research. The first edition of 1,000 copies was exhausted within a week of publication. The new edition contains much valuable additional matter.

THE SOCIETY OF DYERS AND COLOURISTS.—MANCHESTER SECTION.

The Annual Sectional Meeting.

The Annual Report.

The Hon. Sec. then read his Annual Report of the proceedings of the Section, in which it was stated that the total membership of the Section was 394, this being an increase upon the previous year. The following papers had been read at the General Meetings: " Methods for the Identification and Valuation of Coals," by Capt. F. S. Sinnatt, M.B.E., M.Sc.Tech., F.I.C., M.I.M.E.; " On the Behaviour of Oxidised Cellulose towards the Direct Cotton Colours," by Prof. E. Knecht, Ph.D., M.Sc.Tech., F.I.C.; " Notes on Fur Dyeing," by W. F. A. Ermen, M.A.; " On the Estimation of Indigotin," by Wm. Thompson, F.R.S. (Ed.), F.I.C.; " Some Laboratory Notes," by Prof. E. Knecht, Ph.D., M.Sc.Tech., F.I.C.; " A Note on the Tinctorial Value of a Sample of Mauve made about the year 1864," by Miss Eva Hibbert, M.Sc.Tech.; " On the Inter-relation of Mercerisation and Spinning," by Horace Lowe; " On the Tinctorial Properties of Some Anthocyans and Certain Related Pigments," by A. E. Everest, D.Sc., Ph.D., F.I.C., and A. J. Hall, B.Sc., F.I.C.; and " On the Effect of Scouring and Bleaching upon the Structure and the Strength of Cotton Fabrics," by J. Huebner, M.Sc.Tech., F.I.C. The attendances at the meetings of the Section had been very satisfactory. Arrangements have been made for five further meetings, at which papers of interest and value will be read and discussed.

THE CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, May 4th, 1922, at 8 p.m.

The following papers will be read:—

Brome-derivatives of glyoxaline.—I. E. Balsban and F. L. Pyman.

The properties of ammonium nitrate. Part IV.: The reciprocal salt-pair $NH_4NO_3 + NaCl \quad NH_4Cl + NaNO_3$.—E. P. Perman.

The reactivity of ammonia.—E. G. C. Baly and H. M. Duncan.

Photocatalysis. Part II. The photosynthesis of nitrogen compounds from nitrates and carbon dioxide.—E. C. G. Baly, I. M. Heilbron and R. P. Hudson.

" THE PREPARATION OF CLOTH FOR FINISHING."

By S. H. Higgins, M.Sc. (Bleachers' Association, Limited), and Andrew Hodge (Calico Printers' Association, Limited).

The paper commenced by a reference to the statement of Mr. W. Howarth at the World Cotton Congress, Manchester, 1921, respecting the characteristics of raw cotton

which enabled a spinner to attain the best results with a minimum of labour, i.e., the fibres must be even in length, the cotton must be ripe, the grade must be even, and the cotton must be as free as possible from "dead" cotton, bearded motes, seed, fibres other than cotton, sand, iron, stones, excessive moisture and other foreign substances. The finisher's objective was also to achieve the best results with a minimum of labour, and his success was very closely dependent of the success of the spinner in obtaining supplies possessing the characteristics referred to by Mr. Howarth. By full discussion of the difficulties caused by the lack of these characteristics, not only in spinning, but in the subsequent processes of bleaching, dyeing, printing and finishing, it was believed that the spinner's hands would be strengthened in his attempts to secure the quality of cotton he requires.

The faults in cotton piece goods which hamper the finisher in his attempts to produce the best result are, roughly, cotton faults, mechanical faults, and chemical faults, including those associated with the size.

Dealing with cotton faults, it was stated that "black" cotton could not be bleached to a pure white, the finished piece being dull and almost grey in appearance. Cloth woven from such "black" cotton should never be delivered to White finishers or Calico printers, but should be sent for black dyeing. Blue Bender cotto nis a variety of Peeler cotton, and had a blueish colour which could not be removed by the usual methods of bleaching. The name is given owing to the fact that it grows in the bends of the Mississippi River Valley. Some authorities are of opinion that its coloration is brought about by premature frost, while others think it is due to some ingredient in the soil. Apart from its colour and resistance to bleaching, the appearance and quality of the fibre are unimpaired. The United States Department of Agriculture finds that middling tinged cotton, when bleached, can be used for dyeing both light and black shades, but good middling blue stained and middling blue stained can only be bleached satisfactorily for dyeing dark shades.

Unripe fibres are responsible for spinning difficulties resulting in the formation of neps resisting the penetration of the colour. Many cloths, particularly those woven with the coarser counts of yarn, contain a very large proportion of leaf which remains from a pale buff yellow to dark brown after the goods have received a normal bleach. This is a very objectionable feature in many styles, and at its worst leaf is also capable of showing speckiness in the ultimate dyed goods as illustrated in one of the examples.

The mechanical faults took the form of unevenly spun yarns, uneven weaving, floats, etc., the most outstanding of them all being probably uneven weaving, which gives alternatively thick or thin places in the weft, or reediness in the warp, and which, although in many cases hardly noticeable in the grey, show up in the ultimate dyed or printed goods as light and dark places, constituting what is known as streaminess. A defective sand roller on a loom sometimes causes minute holes in the cloth, which are enlarged in the bleaching process. The temple of the loom causes similar holes, but at the sides of the cloth, while the grey plaiting machine also causes damage from time to time. These damages in the form of small holes are difficult to trace to their source. Pins, teeth of steel combs, hairpins, etc., left in cloth by weavers cause stains and tears. It is quite customary to find heddle wires in calenders from goods woven in Jacquard looms, thus causing small round holes to be cut in the cloth going through the calenders. Cropping machines sometimes cause small holes by pulling bits of cloth out along with the loose threads, and can also damage cloth by the blades not being properly adjusted.

The paper also dealt with the structure of the selvedge, which was a matter of importance to the finisher. In some cases a curling selvedge rendered printing, dyeing and finishing difficult if not practically impossible. In order to obtain certain finished effects a definite process must be followed and the cloth must have a definite large number of runnings, but if finishers give more runnings to the cloth than is absolutely necessary, the cost of production is too high. If selvedges are hard and round, instead of having a flat tape appearance, they are liable to cut or tear away from the body of the cloth, and if the threads in the selvedge are badly drawn they tend to form a hard, solid selvedge, which may be an advantage in weaving, but gives trouble when calendered. Irregularity in the manner of threads in a selvedge caused by bringing in loose ends will sometimes cause damage in those places where

extra threads have been introduced. There would be little trouble with faulty selvedges if the whole-hearted co-operation of the mill manager could be obtained.

With regard to chemical faults, including those associated with size, these took the form of excessive quantities of size being used, and from the use of undesirable ingredients in the size, such as zinc and magnesium chlorides, paraffin wax or tallow containing paraffin, and from the use of colouring matters which cannot be bleached out. All the size put into the warp has to be removed by the finisher during the process of bleaching, and the less he has to remove the better. Many cloths are now delivered free from chlorides, though some of the ready-made softeneds sold for use in sizing contain chlorides, and a manufacturer buying such products might be using them unwittingly. The use of China Clay in sizing light goods is also not to be recommended. Fatty matter in the size is a fruitful source of trouble to the finisher, even when it consists of pure tallow which is mainly saponifiable. Some cloths contain as much as 2.5 per cent. of fatty matter while other similar cloths only contain 0.6 per cent. Many commercial tallows are adulterated with unsaponifiable paraffin wax which is not removed in the process of bleaching, and gives rise to stains in the finished goods. Japan wax, being only partially saponifiable, is not suitable for sizing mixings. Paraffin and similar waxes should not be allowed in the weaving shed.

The practice of covering up a float or other weaving defect with paraffin wax, or soap containing it, is also to be deprecated.

Stains due to mineral oil are another difficult problem from the point of view of the finisher. They occur when there is contact with the yarn or cloth in the course of spinning or weaving, from drippings from the roof or from the slasher cylinder covers, yellow or black bars from cracked bobbins, the oil getting on to the roving, or oil from the roller necks, and in the top boards in the card room. When the weaver pieces a thread an oil stain will result if she has oil on her fingers, and this stain cannot be removed in the ordinary bleaching process. Marks from picker bands due to oily and waxy matters in the stuffing of the leather will not come out, but leave yellow marks. If lubricating oil has come from a bearing and contains any copper or iron from the machinery the trouble is greatly aggravated. The metallic particles are not completely removed by scouring, and act on the chemic, giving off oxygen, thus tendering the cotton with which they are in contact. It is an exceedingly dangerous practice to attempt to remove these metallic stains by treatment with Oxalic Acid or Salts of Sorrel. If the acid is not completely remove by washing, local, and perhaps more than local, tendering may occur. Lard oil is saponifiable in the bleaching process. Some years ago it was shown that by using a lubricating oil containing 75 per cent. of colza oil and 25 per cent. of mineral oil any oil stains would be removed in the bleaching process. White lead stains from looms and other parts of the textile machinery will not bleach out, but leave light brown stains. The bleeding of dyestuffs in the bleaching process also causes a considerable amount of trouble. It is more likely for variations to take place in the process of dyeing, which is sometimes a long and difficult one, than in the process of bleaching, which is more or less standardised.

Difficulties also occur when "gold headings" have to be dealt with by the bleacher. There appear at times to be variations in the quality of the gold thread, blackening of the thread and the tendering and destruction of adjacent cotton threads. Manufacturers have at times bought inferior gold which would not stand the bleaching process. Instead of being a drawn silver wire with an extremely thin coating of gold, it has sometimes been a gilt copper wire.

If attempts are made to remove foreign matters, such as paraffins, by more drastic methods of bleaching, the finisher runs two serious risks; first, that of rendering his cloth unsuitable for the finished effect required, and, second, of weakening or actually rotting the cloth. Otherwise the finisher is continually attempting to remove all foreign matters as completely as possible.

The finisher ought to insist that no chlorides or unsaponifiable waxes shall exist in the cloth he receives.

With regard to stretching goods to width it must not be forgotten that there is a certain amount of stretch which can be given to fabrics beyond which the strength of the fabrics is decreased.

A discussion followed, in which Messrs. Knecht, Hannay, Thomson, J. Campbell Gray and Jones took part.

Mr. J. Campbell Gray proposed, and Mr. Jones seconded, a vote of thanks to the authors for their paper, and to Dr. Harland for his explanation of the screen illustrations.

[*Abridged report, by F. W. Baber, of a paper read before Society of Dyers and Colourists, Manchester Section, on Friday, April 21st, 1922.*]

CHEMICAL NOTICES FROM FOREIGN SOURCES

THE MONOCHLORTOLUENES—*A. Wahl, G. Normand, and G. Vermeylen.*—The chlorination of toluene leads to the formation of a mixture of ortho and parachlortoluene, the properties of which have been variously described by different authors. The study of the density of the product obtained in presence of 2.5 to 3 per cent. of iron shows that between temperatures of 0° and 20° the composition is practically 57 or 58 per cent. of the ortho to 43 or 42 per cent. of the para compound. The influence of the temperature is only very slight, and chlorinations performed at 30°, 40°, 50°, and 60° lead to almost the same result. If aluminium is used instead of iron in the chlorination, the mass becomes coloured, and on distillation an abundant residue of polymerised products is left. The authors have not been able to observe any reaction when toluene is chlorinated in presence of ammoniacal lead tetra chloride. In presence of $PbCl_2$ chlorine begins to act at the temperature of the water bath, but while in absence of a catalyst only benzyl chloride is formed, in presence of $PbCl_2$ toluene chloride is chiefly formed, the percentage of ortho compound being about 62, or slightly above the normal amount.—(*Comptes Rendus*, CLXXIV., 1922 ,No. 14.)

TITRIMETRIC DETERMINATION OF ALUMINIUM—*E. J. Kraus.*—The aluminium is precipitated as hydroxide, and after separation from iron is dissolved in sulphuric acid, the amount of acid used being such as to make the solution neutral or very slightly acid. Then some drops of a solution of silver nitrate are added, and the solution is titrated with a standard solution of Na_2HPO_4, which produces a white precipitate of $Al PO_4$. The end point of the reaction is reached when a drop of the reagent causes a yellow colouration due to the formation of $Ag_3 PO_4$.—(*Chem. Zeit.*, XLV., 1921, p. 1,178.)

DETECTION OF SMALL QUANTITIES OF PYRIDINE—*A. Goris and A. Larsonneau.*—To detect pyridine in the volatile bases obtained from belladonna leaves, the authors made use of the fact that pyridine combines with $C_6H_5NH_2$ in presence of CNBr to give a red crystalline compound of melting point 162°, viz.,α-anilido-phenyl dihydro-pyridinum bromide. One drop of aniline, one drop of pyrdine, 1 or 2 cc. of water ,and 0.05 to 0.1 gr. of freshly prepared CNBr are mixed, and at once a red precipitate of crystalline needles is formed. By means of this reaction, one drop of pyridine can be detected in ten litres of water. The reaction is not given by pyrrolic derivatives and can therefore be employed to detect pyridine in presence of methyl-2-pyrrolidine, which is very abundant in the volatile alkaloids obtained from belladonna leaves.—(*Bull. Soc. Pharm.*, XXIII., 1921, p. 497.)

ZIRCONIA AND ZIRCONIUM.—The two chief sources of zirconium are zircon, or zirconium silicate $ZrSiO_4$, found in Norway and in Ceylon, and brazilite, zirconium, oxide ZrO_2, found also in Ceylon and in Brazil. Pure zirconia is one of the most refractory substances known, its melting point being 2,950°. Like fused silica, it can be subjected to abrupt changes of temperature without being broken. In hardness it is intermediate between quartz and corundum. Chemically, it is very inert, being unaffected both by acids and alkalies, and in this respect is unlike any other refractory substance. It is used to make a silica glass, known as siloxide, in the enamel industries, in the manufacture of electric porcelain, and as a refractory material. It can be employed for making laboratory ware such as crucibles, tubes, etc. Platinum can easily be fused in zirconia crucibles, and they can be employed in studying the boiling point of pure iron. In order to prepare zirconium it is best to reduce zirconia either by means of aluminium or by calcium. An intimate mixture of zirconia and calcium filings in excess is heated in an iron tube at a pressure of 0.1 to 0.5 mm. of mercury till the reaction begins; then the contents of the tube are cooled, powdered, treated with cold water, acetic acid, dilute hydrochloric acid, and water, so as to eliminate the calcium. The product is finally washed in acetone and dried in vacuo, all these operations taking place in absence of air. Zir-

conium is a greyish metal, similar to silicon. *Like nickel, it can be highly polished.* It melts at about 1,600°, and its hardness is 6.5. It gives alloys with iron, nickel and aluminium, and is almost unaffected by acids, except aqua regia and hydrofluoric acid. It is used in the form of alloys or as zirconium steel; one alloy containing 56 *per cent. of zirconium,* 26 *per cent. of iron,* 9 per cent. of aluminium, and 9 per cent. of titanium, is almost inoxidisable and fusible only with great difficulty. It is proposed to use it to replace platinum.—(*L'Age de Fer*, XXXVIII., 1922, 1,572.)

GENERAL NOTES

DETERMINATION OF SOLUBILITY.

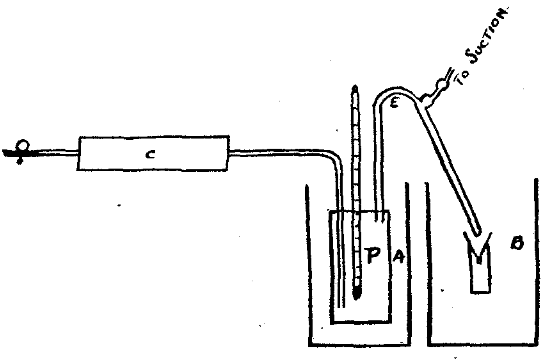
By G. W. Walker.

The author had occasion to determine the solubilities of various solids in water at different temperatures. The usual method of forming a saturated solution then filtering off a portion was found to be unsatisfactory on account of loss of temperature during manipulation. The difficulty is obviated by use of the apparatus as in sketch.

The beaker A contains water or other suitable liquid in which the flask containing the solid and solvent is held. B is an air-bath containing the filter and weighing bottle. C is a combustion tube containing potassium hydroxide to eliminate CO_2 from the air.

Hot air is drawn through the apparatus, and serves to keep the solid in agitation. When the requisite temperature has been reached, the leading tube E is inserted into the saturated solution and suction gently applied. Some of the contents of F are then filtered off and at the required temperature. Of course the air-bath is kept at the necessary temperature.

Careful manipulation will give satisfactory results over a range of temperatures.



AN ALLEGED SYNTHESIS OF AMMONIA.

By A. J. Prince, Research Student, East London College.

In the German Patent No. 74,275, entitled "A Process for the Synthetic Preparation of Ammonia," de Lambilly states that an increased yield of synthetic ammonia should be obtained if, instead of dry gases, nitrogen and hydrogen saturated with water vapour are employed, thereby producing ammonium hydrate. Further: "Ammonia in the presence of an acid, or what amounts to the same thing, ammonium hydrate in the presence of an acid anhydride, behaves as an energetic base, . . . and hence, if to the correct nitro-

gen and hydrogen mixture, the anhydride of formic acid, viz., carbon monoxide, is added, then, when saturated with water vapour, the mixed gases should react in the presence of certain porous bodies, with production of ammonium formate." As suitable catalysts, pumice, wood-charcoal and bone-charcoal are mentioned, while platinum sponge and platinum black are especially recommended. The best yields should be obtained between the temperatures of 80° C. and 130° C.

Such a process as this would be of the utmost importance to the synthetic ammonia industry, since it provides an easy and efficient method of manufacturing ammonium salts from water-gas. With the idea of investigating its possibilities in this direction, the patent was tested on a small laboratory scale.

Hydrogen and carbon monoxide, prepared and purified by the usual methods, were mixed in the proportions required by the equation:—

$$N_2 + 3H_2 + 2CO + 2H_2O = 2H.COONH_4$$

with pure compressed nitrogen from a cylinder, and the mixture bubbled through ammonia-free water at 65° C. In this way, the gases were saturated with water vapour, which at this temperature exerts a pressure of 190 mms. The mixture was then passed through the catalyst chamber, consisting of an ordinary Liebig's condenser tube enclosed in a steam jacket. The gases then attained a temperature of 100° C., and the partial pressure of the water vapour would be that demanded by the above equation. The catalyst employed was freshly prepared platinised asbestos. On their exit, the gases were bubbled through ammonia-free water. In all, about 13 litres of the mixture were passed slowly through the apparatus, but in spite of the fact that a favourable temperature was employed there was no appreciable production of ammonium formate; no precipitate was given with either Nessler's solution or with silver nitrate. One is forced, therefore, to the conclusion that, even on the laboratory scale, the process is quite useless. This, after all, is to be expected, since the patent is based on the false and obsolete doctrine of "Predisposing Affinity" (see Ostwald, "Lehrbuch," II., 2, p. 30). The process, however, is often quoted in the literature (see, for example, Knox: "Fixation of Nitrogen," 1921, p. 83, and Stewart: "Recent Advances in Physical and Inorganic Chemistry," 1920, p. 25).

I wish to thank Prof. Partington for

IRON FOUNDING AND RESEARCH.

The Duke of York has promised to visit the Foundry Trades Exhibition, which is to be held at Bingley Hall, Birmingham, on June 20-23. It has been organised by the Institution of British Foundrymen, which will then be meeting in conference in Birmingham, and simultaneously the Institution of Automobile Engineers and the Municipal Electrical Association will also be holding conferences in Birmingham. The British Cast Iron Research Association is largely interested in the Foundry Trades Exhibition (of which Lord Weir is President), this being the first of its kind held in Europe. The Institution of British Foundrymen was founded in 1903 in Birmingham (which possesses more foundries in its area, 118, than any other English town or city), and has over 2,000 members. The largest single county foundry area is Yorkshire, with 408. There are nearly 3,000 iron foundries in Great Britain and Ireland, and these are divided as follows: England: North Counties (Northumberland, Cumberland, Durham, Westmoreland, Lancashire, Yorkshire), 881; Midland Counties (Staffs., Worcestershire, Warwickshire., Leicester, Derbyshire, Notts., Northamptonshire), 828; West Counties (Wales 84, Chester, Salop, Hereford, Monmouth, Gloucester, Somerset, Devon, Cornwall), 321; East Counties (Lincoln, Norfolk, Cambridge, Hunts., Suffolk, Essex, Beds., Bucks., Herts.), 174; South Counties (Berkshire, Wilts, Dorset, Hants., Sussex, Surrey, Kent, Middlesex, Oxford), 137; London, 98; Scotland, 305; and Ireland, 52.

The cast iron trade has been singularly lacking in the application of science to the industry, and the new movement, which is intended to repair the deficiency, has the support of large numbers of leading industrial chemists and metallurgists. This effort to bring science into closer relationship with the industry is the outcome of our war experiences, when the best brains of the country and the resources of the laboratory were called upon either to expedite production. To stimulate effort in repairing deficiences which had become painfully manifest, the Government placed a fund of a million sterling at the disposal of the Research Dept., and the hope is entertained that by means of a bureau of technical data and the laboratory the malleable cast iron trade may become up-to-date and more scientifically conducted. The situation in this respect certainly shows some improvement already.

POLYMERISATION.

To the Editor of the "Chemical News."

Fleetwood, April 22.

SIR,—I shall be glad if you will allow me to correct two printer's mistakes which have crept into my article on "Polymerisation at the Critical Temperature."

(1) For $\frac{T_c + p + s}{R_T} = 22.15$

read $\frac{T_0 \, p \, s}{R_T} = 22.15$

(2) The formula I suggested for Van der Waal's was

$$\left(P + \frac{a}{v^2} \right) \left(v - \frac{b}{\sqrt[3]{p}} \right) = RT.$$

Yours truly,
W. R. FIELDING.

NOTES ON BOOKS.

Organic Analysis, qualitative and quantitative, by E. DE BARRY BARNETT, B. Sc., F.I.C., and P. C. L. THORNE, M.A., A.I.C. Pp. XII. + 168. London: University of London Press, Ltd., 17, Warwick Square, E.C.4, 1921. Price 7s. 6d.

This book is intended as a companion to the works on the preparation of organic compounds.

In the part dealing with qualitative analysis, the authors lay stress on the systematic detection of groups, and do not attempt to devise a scheme for the identification of every organic substance. The usual analytical procedure is given—tests for elements, separation into classes, identification by properties. The latter sometimes receive scanty mention, but the student is advised and encouraged to consult Richter's *Lexikon* and Beilstein's *Handbuch*. To this end an appendix indicates the way to use these works of reference.

Instructions for conducting quantitative analyses are given in Part II., together with the Physical and Chemical methods for determining molecular weights. The Estimation of Groups and individual substances receives especially good treatment, and in the early chapters, due importance is attached to the determination of physic constants, including refractive indices.

The methods selected and the apparat figured are generally the best, but this ca

The book should prove useful to students reading for University examinations, or those of the Institute of Chemistry.

J. G. F. D.

Coal Tars and their Derivatives, by Dr. G. MALATESTA, translated from the first Italian edition, with revisions, corrections and additions by the author. Pp. XII. + 530. London: E. and F. N. Spon, Ltd., 1920. Price 21s. net.

In translating his Italian treatise on the production of tar, Dr. Malatesta has taken the opportunity to revise it and make additions.

This industry has now attained colossal dimensions, as evidenced by statistics of the production and exports of various countries.

Part I. is historical. It details the various manufacturing processes and plant. Tars formed by distilling oils, lignite, peat, and wood are also described. A brief account of the individual constituents and their uses concludes this section.

Part II. deals with the distillation and fractionation of tar and the rectification of the various "oils," together with the manufacture of pitch, asphalt and bitumen.

Part III. gives the analytical methods adopted.

The book contains many useful tables, and is fully illustrated with very good diagrams. The wording of those on pages 141-143 is in Italian, and in the next edition the author could give the usual synonyms on page 262. $C_7 H_{16}$ should be Heptane, not Eptane. A few other obvious errors appear.

It seemed necessary to notice these small defects, which, however, scarcely detract from the unquestionable value of this work, which will be widely read in industrial circles.

J. G. F. D.

The Principles of Symmetry and its applications in all Natural Sciences, by F. M. JAEGER, Ph.D. Second, augmented edition. Pp. XII. + 348. Amsterdam: "Elsevier" Publishing Company, 1920.

This book, dedicated to Sir W. J. Pope, is of a most unusual character, and originated in a series of lectures by the author, whose purpose is to draw attention to a principle, the signiqcance of which, in biological morphology, and especially in

The general doctrine of symmetry and its laws are confined to four chapters. The tendency towards symmetry is one of the great natural laws, and is an instance of the general scheme towards stability. The laws of symmetry apply not only to inorganic crystals, but to phenomena in the animal kingdom and to floral structures. Some botanists will not agree with the author's inclusion of phyllotaxis as an exemplification of his theories.

An adequate and correlated account of the achievements of many investigators in different fields is given, and includes those of Pope and Kipping on the asymmetric atoms of elements of valency greater than 2, and the theories of Van't Hoff and Le Bel. It also includes the work of Brevais, Sohncke, Schönflies, Fedorov, Barlow and others. Not least among these are his own contributions to our knowledge on this subject.

From Pasteur's resolution of racemic acid into two optically active compounds the development of this subject is treated in detail.

Werner's work on the optical activity of complex inorganic compounds is reviewed, and the improbability of some of his conclusions is indicated.

There are copious references to the literature, and surprisingly few errors occur. The illustrations are clear and good, and the English is remarkably good. This very inspiring book should receive the careful attention of investigators in many diverse fields. J. G. F. D.

Inorganic Chemistry, by T. MARTIN LOWRY, C.B.E., M.A., D.Sc., F.R.S. Pp. X. + 943. London: Macmillan and Co., Ltd., 1922. Price 28s. net.

The boundaries of the various branches of Chemistry are gradually becoming less recognisable. This is largely due to the advances made in Physical Chemistry, and is most noticeable in Inorganic Chemistry.

Prof. Lowry has indicated the importance of a complete understanding of Physical Chemistry in studying the Inorganic branch of the science. The first part of his treatise is largely historical, and the fundamental chemical theories are introduced in a logical manner. Part II. gives a very full account of the preparation, properties, compounds and uses of the non-metals.

Parts III. and IV. deal respectively with the "Typical" and "Transitional" series of metals, following Mendeléeff's classification. The chapter on the Classification of the Elements incorporates all important modern conclusions, and is especially good. The author might have emphasised, however, that less significance is now attached to Lothar Meyer's Atomic Volume curves.

Equilibrium diagrams have been freely used, particularly in the study of alloys. Important industrial operations are carefully described, and the illustrations of crystals and apparatus are also particularly good.

An account of the natural silicates is given, indicating their importance in mineral chemistry, and special chapters are devoted to the Structure of Crystals, the Radioactive Elements, Isotopes, Photography, etc.

Tables of the elements appropriately include the Atomic Numbers as well as Atomic Weights.

Very few errors have been noticed, the most serious being that H.SnO.ONa is termed *sodium stannate* on p. 686.

Altogether this is a very suitable textbook for students, and will doubtless be consulted and freely used by more experienced chemists. J. G. F. D.

Exploitation du Petrole par Puits et Galeries, par Paul de Chambrier, Directeur général des Mines de Péchelbronn, Chargé d'un cours libre à l'Université de Strasbourg; pp. 106 + map. Paris: Dunod, Editeur, 1921. Price 5fr.

The success which has attended the tests on the exploitation of petroleum at Péchelbronn in Alsace, by systems of wells and galleries has prompted M. de Chambrier to make them permanently available. He hopes that others will thereby be encouraged to adopt these methods, particularly in those oilfields where the yield of crude oil could be increased. Methods of working and general statistics are given which enable a comparison to be made between the yields obtained by the methods used in the United States and those of Alsace.

A theoretical explanation is put forward of the oozing of oil in the drainage galleries together with a new process of estimating reserves.

The book, which is also a summary of the author's lectures at the University of Strasbourg, is certainly worthy of the careful consideration of technologists engaged in this branch of applied science. J.G.F.D.

New Patents.

THIS list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

9564—Adam, W. G.—Chemical reduction of organic compounds, etc. April 3.

9765—Carmichael & Co., Ltd., J. E.—Means for elevating and controlling supply of acids, etc. April 5.

9681—Chemical Engineering Co., Ltd.—Processes for producing intimate mixtures of substances and for obtaining chemical products therefrom. April 5.

9828—Dutt, E. E.—Process for extraction of titanium dioxide and vanadium salts from bauxite. April 6.

9792—Green, A. G.—Preparation of azo-compounds. April 5.

9734—Loring, F. H.—Method of refining metals. April 5.

Specifications Published this Week.

177189—Dreyfus, H.—Manufacture of alkyl sulphates.

153916—Muckka, J.—Preparation of inert gas mixture of nitrogen and carbon dioxide by means of internal combustion engines.

168573—Emerson, V. L.—Processes and apparatuses for the conversion of hydrocarbon oils.

156177—Trauns Forschungslaboratorium Ges, H.O.—Process for the manufacture of hexamethylene tetramine and formaldehyde.

155735—Stockholm Superfosfat Fabriks Aktiebolag.—Method of manufacturing acetaldehyde from acetylene.

177310—British Cellulose & Chemical Manufacturing Co., Ltd.—Manufacturing of pyrosulphates.

Abstract Published this Week.

Potassium Chloride.—Patent No. 175,348.—A method of obtaining Potassium Chloride has been devised by Mr. G. A Blanc, of 56, Via Via Fontanella di Borghese, and F. Jourdan, of 186, Via del Babuino, both in Rome.

Rocks containing potash, such as leucite, are treated in counter-current in a furnace with gaseous hydrochloric acid, the temperature being about 600° C. at the outlet, 300° C. at the inlet end. The chlorides other than alkali chlorides are decomposed by the time the material reaches the outlet end, and the chlorides are leached out from the product. The hydrochloric acid may be produced by the Hargreaves process, using the potassium chloride produced by the main process, the hydrochloric acid being used directly in the hot state.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each.

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Particulars may be obtained from Hertford Record Co., Ltd., of Lindsey House, 59, Lincoln's Inn Fields, London, W.C.2.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

PHENOL PRODUCTS.

THE PROPRIETOR of British Letters Patent No. 9291, of 1914, is prepared to sell the Patent or to license British Manufacturers to work under it. It relates to an improved method of manufacturing condensation products of phenol and substances containing the methylene radical.

Address:— B. W. & T.,
111 & 112, Hatton Garden,
London, E.C.1.

THE CHEMICAL NEWS,
VOL. CXXIV., No. 3239.

NATIONAL ALLIANCE OF EMPLOYERS AND EMPLOYED.

INDUSTRIAL PARLIAMENT.

Having regard to the widespread interest which is being taken in the idea of forming some joint organisation representative of Employers and Employed, by way of an Industrial Parliament or otherwise, it may be useful to give an idea of the experience and success of the National Alliance of Employers and Employed in attempting a similar object.

It has probably been the experience of all who have attempted pioneer work in Industrial or Trade Organisation that the leaders in the earlier stages must be individuals working as such. Until substantial progress has been made the official support of other organisations is difficult to secure. At the same time, it is certain that no joint organisation can be really effective unless it is founded on a representative basis, that is to say, on a basis of Employers' Associations and Trade Unions or branch Trade Unions represented on the administrative committees of the joint organisation by their duly-authorised nominees.

The Alliance has now passed through the first or individualistic stage, and the next few weeks will see its new representative Constitution an accomplished fact.

CONSTITUTION OF NATIONAL ALLIANCE OF EMPLOYERS AND EMPLOYED.

MEMBERSHIP.

The Alliance shall consist of:—

1.—Full Members.

(*a*) Employers' Associations, Companies or Firms.

(*b*) Trade Unions or Federations of Trade Unions.

2.—Associate Members.

Persons in sympathy with the objects of the Alliance and approved by the National Executive Committee or by the Area Committee of the locality in which they reside.

ADMINISTRATION.

The affairs of the Alliance shall be conducted by:—

1.—A General Meeting of Members.

2.—A General Council.

The General Council shall consist of:—

(*a*) One Employer and one Trade Unionist from each Area Committee.

(*b*) Two members from each affiliated Employers' Association and Trade Union.

(*c*) Associate members co-opted by the General Council to a number not exceeding 25 per cent. of the total strength of the General Council.

In making such co-option the General Council may take into consideration any nomination received from the National Executive Committee or Area Committees.

This General Council shall be equally balanced of Employers and Employed, Class (*c*) to be drawn upon when necessary to maintain the balance. Members under Sections (*a*) and (*b*) shall elect annually a National Executive Committee not exceeding forty in number. The General Council may delegate such functions and powers as they may determine to the National Executive Committee, Area Committees and any other Committees which it may appoint. The General Council shall meet not less than three times a year to receive reports from their National Executive Committee, and give general directions as to the policy to be pursued by the Alliance.

3.—The National Executive Committee.

The National Executive Committee shall not exceed forty in number. Half its members shall be composed of and elected by members of Section (*a*) of the General Council, and the other half shall be composed of and elected by members of Section (*b*).

4.—Area Committees.

An Area Committee may be elected by the members of the Alliance in any area, the boundaries of such area being defined by the General Council. Such Committees shall comprise the following:—

(*a*) EMPLOYERS. — Representatives of local Employers' organisations and individual firms.

(*b*) TRADE UNIONS. — Representatives of local Trade Union branches and any other bona fide Labour organisations.

(*c*) ASSOCIATES. — Any individual who is not a representative under Classes (*a*) and (*b*) and is co-opted by the Area Committee.

5.—On all Committees Employers and Employed shall be represented in equal numbers.

The Labour side of the Alliance Executive includes delegates from the following National Trade Unions:—

General Federation of Trade Unions.
The Shipping Guild.
National Sailors' and Firemen's Union.
Workers' Union.
Iron and Steel Trades Confederation.
Coal Trimmers' Union.
Steel Smelters.
Amalgamated Society of Felt Hatters.
Anchorsmiths and Shacklemakers.
Dockers' Union.

In the Provinces over 2,000 (two thousand) Trade Union Branches have officially declared themselves in support of the principles and methods of the National Alliance of Employers and Employed. This number includes the following:—

Class of Craft or Industry.	Branches.
Agriculture	50
Bakers and Confectioners	49
Boots, Shoes and Leather	61
Building Trades	160
Clerical	92
Coal-mining	42
Distributive Trades	57
Engineering	201
General Workers	346
Glass Workers	28
Metal Industries	156
Printing Trade	83
Teaching Profession	49
Textile	109
Transport (including Railways)	175
Miscellaneous	200
also 13 Trades and Labour Councils (approx.)	260
	2,118

The Employers' Federation represented officially upon the Executive of the Alliance include the

Federation of British Industries.
The National Federation of Iron and Steel Manufacturers.
Brassfounders' Employers' Association.
Associated Chambers of Commerce.
Inc. Federated Association of Boot & Shoe Manufacturers.
Central Landowners' Association.

and in addition representatives of local Associations and Federations of Employers and Chambers of Commerce throughout all districts where Area Committees of the Alliance are formed.

PROCEEDINGS AND NOTICES OF SOCIETIES.

ROYAL SOCIETY.

List of Papers Read on May 11th, 1922.

Lord Rayleigh, F.R.S.—A Photographic Spectrum of the Aurora of May 13th-15th, 1921, and Laboratory Studies in connection with it.

Lord Rayleigh, F.R.S.—A Study of the Presence or Absence of Nitrogen Bands in the Auroral Spectrum.

C. Chree, Sc.D., F.R.S.—The 27-day Period (Interval) in Terrestrial Magnetism.

M. Barker.—On the use of very small Pitot-tubes for measuring Wind Velocity. Communicated by Mr. G. I. Taylor, F.R.S.

E. T. Paris.—On Doubly-resonated Hot-wire Microphones. Communicated by Prof. H. L. Callendar, F.R.S.

Prof. J. C. McLennan, F.R.S., and D. S. Ainslie.—On the Structure of the Line of Wavelength = 6708 A.U. of the Isotopes of Lithium.

At 4 p.m.—Election of Fellows.

Thursday, May 4th, 1922, at 4.30 p.m.

Papers to be Read:

C. Shearer, F.R.S.—On the Heat Production and Oxidation Processes of the Echinoderm Egg during Fertilisation and Early Development.

Johan Hjort, For. Mem. R.S.—Observations on the Distribution of Fat-soluble Vitamines in Marine Animals and Plants.

H. Hartridge and R. A. Peters.—Interfacial Tension and Hydrogen Ion Concentration. Communicated by Mr. W. B. Hardy, Sec. R.S.

W. Cramer, A. H. Drew, and J. C. Mottram.—Blood-platelets and their Behaviour in "Vitamin A" Deficiency, and after "Radiation"; and their Relation to Bacterial Infections. Communicated by Prof. W. Bulloch, F.R.S.

It is usually possible for a Fellow to obtain an abstract of a paper in which he is interested, by application to the Assistant Secretary a day or two in advance.

At the meeting of June 1, the Croonian Lecture will be delivered by Prof. T. H. Morgan, of Columba University, on "The Mechanism of Heredity."

ROYAL INSTITUTION.

The Annual Meeting of the members of the Royal Institution was held on Monday, the 1st of May, Sir James Reid, Bart, Vice-

President, in the chair. The Annual Report of the Committee of Visitors for the pear 1921, testifying to the efficient management of the Institution, was read and adopted. The Report of the Davy Faraday Research Laboratory Committee was read. Fifty-seven new members were elected in 1921, and 63 lectures and 19 Evening Discources were delivered. The books and pamphlets presented amounted to about 210 volumes, making with 441 volumes (including periodicals bound) purchased by the managers, a total of 651 volumes added to the Library in the year. Thanks were voted to the President, Treasurer and Secretary, to the Committees of Managers and Visitors, and to the Professors for their valuable services during the past year. The following gentlemen were unanimously elected as officers for the ensuing year:—

President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; Secretary, Col. E. H. Grove-Hills; managers, S. G. Brown, Dr. J. Mitchell Bruce, A. H. Goschen,, Sir Alexander C. Mackenzie, Sir Ernest Moon, The Hon. Sir Charles Parsons, Dr. Alfred W. Porter, Sir James Reid, Bart., the Marquess of Salisbury, K.G., Sir David Salomons, Bart., Joseph Shaw, William Stone, Sir J. J. Thomson, O.M., Sir Almroth Wright, the Right Hon. Lord Justice Younger; Visitors, J. H. Batty, Dr. W. A. Bone, Alfred Carpmael, Dr. E. Clarke, Sigismund Goetze, G. H. Griffin, Dr. J. R. Leeson, Sir Oliver Lodge, P. A. Molteno, Sir Malcolm Morris, Richard Pearce, H. M. Ross, Sidney Skinner, T. H. Sowerby, William A. Tait.

On Saturday next, May 13th, at 3 p.m., Professor O. W. Richardson, D.Sc., F.R.S., will lecture on:—

The Disappearing Gap between the X-ray and the Ultra-Violet Spectra: (1) *Grating Results.*

THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

The following officers and members of Council were elected at the Annual General Meeting of the Manchester Literary and Philosophical Society on Tuesday, April 25th, 1922:—

President, T. A. Coward, M.Sc., F.Z.S., F.E.S.; Vice-Presidents, Sir Henry A. Miers, M.A., D.Ss., F.R.S., W. Henry Todd, Arthur Lapworth, D.Sc., F.R.S., F.I.C., C. E. Stromeyer, O.B.E., M.Inst.C.E.; Secretaries, H. F. Coward, D.Sc., F.I.C., Prof. T. H. Pear, M.A., B.Sc.; Treasurer, R. H. Clayton, B.Sc.; Librarians, C. L. Barnes, M.A., Wilfrid Robinson, D.Sc.; Curator, Prof. W. W. Haldane Gee, B.Sc., M.Sc.Tech.; *Other Members of the Council, W. M. Tattersall, D.Sc., Prof. F. E. Weiss, D.Sc., F.R.S., F.L.S., Francis Jones, M.Sc., F.R.S.E., F.C.S., Miss Laura Start, M.Ed., Prof. Sydney Chapman, M.A., D.Sc., F.R.S., Prof. W. L. Bragg, M.A., F.R.S., the Rev. A. L. Cortie, S.J., F.R.A.S., F.Inst.P., R. L. Taylor, F.C.S., F.I.C., William Thomson, F.R.S.E., F.C.S., F.I.C. (*Ex-officio, The Chairman and the Secretary of the Chemical Section.

THE INSTITUTE OF METALS.

Westminster, S.W.1, 2 May, 1922.

THE RELATION OF THE ELEMENTS.

LECTURE BY SIR ERNEST RUTHERFORD.

Professor Sir Ernest Rutherford, F.R.S., delivered the twelfth annual May Lecture to a crowded meeting of members of the Institute of Metals on Wednesday, May 3, at the Institution of Mechanical Engineers, Westminster. Mr. Leonard Sumner, M.Sc., *President of the Institute*, was in the chair, and was accompanied on the platform by officers of the Institute, including Professor H. C. H. Carpenter, F.R.S. (past President); Sir John Dewrance, K.B.E. (Vice-President); Dr. W. Rosenhain, F.R.S. (Vice-President); Professor T. Turner, M.Sc. (*Vice-President*); Mr. L. Archbutt (Member of Council); Dr. H. W. Brownsdon, M.Sc. (Member of Council); Engineer Rear-Admiral R. B. Dixon, C.B. (Member of Council); Professor C. A. Edwards, D.Sc. (Member of Council); Dr. R. S. Hutton (Member of Council); Mr. F. C. A. H. Lantsberry, M.Sc.Tech. (Member of Council); Mr. W. Murray Morrison (Member of Council); Mr. H. A. Ruck-Keene (Member of Council); Mr. A. E. Seaton (Member of Council); Dr. R. Seligman (Member of Council); Mr. F. Tomlinson (Member of Council); Mr. H. B. Weeks (Member of Council); and Mr. G. Shaw Scott, M.Sc. (Secretary).

Sir Ernest Rutherford said that very rapid strides in the growth of our knowledge of the constitution and relation of the elements has been made in the last decade.

It had become clear that the atoms were electrical structures of the same general type, consisting of a minute but massive charged nucleus surrounded at a distance by a distribution of negative electrons. The work of Moseley had shown that an unexpectedly simple relation existed between the elements. Apart from its mass, the properties of an element were defined by a whole number which represented the charge on the nucleus and the number of the outer electrons. This number also gave the ordinal or atomic number of the element arranged in order of increasing weight. All the known elements were defined by numbers starting from 1 for hydrogen and ending at 92 for uranium, and only a few numbers were missing. The discussion of the structure divided itself into two parts, one the laws controlling the position and movements of the outer electrons, and the other the constitution of the nucleus. After reference to the recent remarkable theories of Bohr to explain the distribution and motion of the electrons and the origin of the periodic variation of the properties of the elements, attention was directed to the structure of the nucleus which was of great complexity in heavy elements. The evidence derived from a study of the disintegration of the radioactive elements showed that the nucleus contained both helium nuclei and electrons, but no sign of the emission of hydrogen nuclei had been observed.

The atoms of the elements were very stable structures, and in order to break them up it was necessary to use concentrated sources of energy to overcome the powerful forces holding the nuclei together. The most suitable agent for attack was the swift alpha particle from radium. The atoms were bombarded by a stream of alpha particles, and occasionally one of the latter passed close enough to a nucleus to effect its disruption. Experiments made by Dr. Chadwick and the speaker showed that in this way swift hydrogen nuclei were liberated from the atoms of nitrogen, fluorine, sodium, phosphorus and aluminium, but the amount of disintegration was on a very minute scale.

It seemed clear that hydrogen nuclei were constituents of the nuclei of these atoms, and were in all probability satellites of the main system. It was believed that the helium nucleus was a secondary structure built up of 4 hydrogen nuclei, and that consequently the nuclei of all elements consisted ultimately of an ordered structure of hydrogen nuclei and electrons. The arrangement of the parts composing the nucleus and the forces operative were quite unknown, and the difficulties of direct attack on this problem of nucleus structure were very great.

The meeting concluded with a vote of thanks to Sir Ernest Rutherford, proposed by the Chairman and seconded by Dr. W. Rosenhain, F.R.S.

BIRMINGHAM & MIDLAND SOCIETY OF CHEMICAL INDUSTRY.

A Study in Modern Agricultural Science.

A joint meeting of the Birmingham and Midland Society of Chemical Industry and the Institute of Brewing was held at the Birmingham University on Thursday, 4th May. There was a large attendance, and Professor Ling presided, Dr. Brownsdon (Society of Chemical Industry) supporting him. Dr. E. J. Russell, of the Rothamsted Agricultural Research Station, spoke on Agricultural Chemistry in relation to Barley. He said that fortunately the far-sighted action of the Institute of Brewing in setting up a research scheme had made it possible to begin a close investigation of the relationship between malting quantity and agricultural conditions. Plots had been lair out on a number of good barley farms in good barley districts, and they were treated in accordance with the following scheme: (1) No manure; (2) complete artificials: 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, 1½ cwt. sulphate of potash per acre; (3) artificials without potash: 1 cwt. sulphate of ammonia, 3 cwt. superphosphate; (4) artificials without phosphate: 1½ cwt. sulphate of potash, 1 cwt. sulphate of ammonia; (5) artificials without nitrogen: 3 cwt. superphosphate, 1½ cwt. sulphate of potash. The yield would be recorded, and the resulting samples of barley would be fully examined by a competent malting chemist for the following properties: Empirical valuation of barley, determination of nitrogen and moisture, 1,000 corn weight, Blaber cupboard process of malting, full analysis of the extract of resulting malting samples. The results would give information of great value on the effect of fertilisers on the yield and quality of barley, and in particular they hoped they would settle a vitally important agricultural prob-

lem—whether the farmer, if he manured properly, could safely aim at the highest crop that would stand up, or whether he must aim at something less, if he wished to maintain a high quality. They could go a lon gway towards settling this difficult matter of manuring barley. Again, it would be a distinct step if they could prove, what was generally accepted, that good malting quality was the same thing as favourable growth and maturation in the second part of the plant's life; it was hoped also to study the effect of variety on malting quality, and thus be able to advise farmers which of the different varieties now existing or to be produced in the future would prove best for them and for the maltster; and finally, they hoped to make an attack on that difficult problem—the chemical characterisation of a good malting barley. The Brewing Research scheme had justified itself, in that for the first time it had set up a co-operation between the maltster, the barley grower, the expert malt and brewing chemists, and the expert in agricultural science.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

Ordinary Meeting, 3rd May, 1922.

Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President) in the chair.

Certificates were read for the first time in favour of:—Messrs. Archibald Steele Whamond, Thomas John Ward.

A Certificate was read for the second time in favour of:—Mr. Frederick Major, B.Sc. (Lond.), A.I.C.

The following were elected Members of the Society: — Messrs. William John Agnew, B.A. (R.U.I.), Arthur Thomas Etheridge, M.B.E., B.Sc. (Lond.), F.I.C., Reginald Ernest Essery, B.Sc. (Bristol), A.I.C., George Girvan Herbert, A.I.C., George Lewis Hutchison, B.Sc. (Lond.), F.I.C.

The following papers were read:—

"Studies in the Titration of Acids and Bases," by J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

"Graphites and other Pencil Pigments," by C. Ainsworth Mitchell, M.A., F.I.C.

"The Sulphuric Acid Reaction for Liver Oils and its Significance," by J. C. Drummond, D.Sc., F.I.C.

"Inadequacy of 'A.H.' Test for Alkalies in Calcium Carbonate," by W. Singleton and H. Williams.

Abstract.

"Studies in the Titration of Acids and Bases," by J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

The application of the newer indicators to the ordinary titrations of acids and bases has been studied, and new indicators or combinations of indicators are recommended, giving sharp colour changes at the end-point and greater accuracy of results than the indicators commonly in use. Methods of determining the hydrogen ion concentration of the true end-point of a titration are described, and a table of titrations is given showing the hydrogen ion concentration of the end-point, the best indicator, the sharpness of the end-point, and the accuracy to which results may be obtained.

Abstract.

"Graphites and other Pencil Pigments," by C. Ainsworth Mitchell, M.A., F.I.C.

Further details are given of the author's microscopical method of examining graphites, the results being compared with the chemical composition of various graphites and pencil pigments (old and modern), including a specimen of graphite from Egypt (B.C. 1500). Analyses are also given of the pigments in typical coloured pencils, and their differentiation in markings on paper are discussed.

Abstract.

"Inadequacy of 'A.R.' Test for Alkalies in Calcium Carbonate," by W. Singleton and H. Williams.

The authors find that the "A.R." method for determining alkalies in calcium carbonate is inadequate, and reuuires revision, as in several samples of "A.R." quality they find that only about 10 per cent. of the total alkalies present in the calcium carbonate are removed by one extraction with distilled water according to the "A.R." method. Even after five extractions of the substance with water, only about 15 per cent. of the total alkalies present were removed, and only about half the total of five extractions is removed by the first treatment.

Abstract.

"The sulphuric Acid Reaction for Liver Oils, and its Significance," by J. C. Drummond, D.Sc., F.I.C.

The chromogenic substance giving the characteristic colour reaction appears to be a normal constituent of the liver, the

author having found it present in the liver of man and twenty-one other animals. It seems to have a distinct relationship to Vitamin A, for example a number of samples of cod liver oil of known purity, classified according to intensity of their colour reactions with sulphuric acid, were found to be also classified in the order of their Vitamin A content. The colour reaction is correspondingly feeble for oils obtained from animals deprived of Vitamin A. Attempts to trace the origin of the chromogenic substance in the food of the cod failed. The few properties of the substance which are known, as well as the available data regarding its distribution, show certain resemblances to the unidentified Vitamin A. Without assuming the identity of the two factors, the author suggests that the association may be of significance.

THE SOCIETY OF DYERS AND COLOURISTS.

The Annual Meeting of the Society was held at the Midland Hotel, Manchester, on Friday, 31st March, 1922, the President (Mr. H. Sutcliffe Smith) in the chair.

In presenting the 28th Annual Report, for the year 1921, the Council is again pleased to be able to record continued progress in the work of the Society.

Twenty-seven original papers (surpassing all previous records) were read before the various Sections of the Society, and published in the *Journal* during 1921. Six original communications were also published.

These 33 papers cover a wide range of scientific and technical subjects, and indicate that both the most advanced theory and the most detailed practical descriptions are alike of interest and value to members of the Society. Sixteen of the papers may be described as chiefly on the practical side, seven as mainly dealing with testing and analysis, seven as mainly chemical, and three as theoretical.

The Annual Meeting and Dinner was held on Friday, March 18th, 1921, at the Great Northern Hotel, Bradford, at which function the presentation of a Perkin Medal was made to Mr. Horace A. Lowe "For the *Production of a Permanent Lustre on Cotton.*"

The Medal of the Worshipful Company of Dyers, London, for the period July, 1919, to June, 1920, has been awarded to Dr. A. E. Everest and a Diploma has been pre-

THE ANNUAL DINNER.

At the close of the Annual Meeting the Annual Dinner was held at the Midland Hotel, Manchester, Mr. H. Sutcliffe Smith, President of the Society, in the chair.

One hundred and seventy members and guests were present.

The President proposed the customary loyal toasts, which were duly honoured.

Sir Philip Lloyd-Greame, K.B.E., M.C., M.P., proposed the toast of "The Society of Dyers and Colourists." He said—Mr. President and Gentlemen: This Society which is, if I may so put it, the intelligence side of the great general staff of the industry, whether its members are the makers or the users of dyes, has a long and honourable history, and among scientific institutions of the country it holds, by right and by reputation, a very high place. I know something of the value of the work which it has undertaken in the past, and I understand that it now proposes to produce a complete Index, in the English language, of all commercial dyes. My acquaintance with the dye industry has not been very long, though it has been very intimate, and I already know enough to be sure that such a work should exist in the English language.

There seems to be hardly any field of enterprise into which dyes, directly or indirectly, are not likely to tnter. Not only are they vital to the greatest industry of this country, the textile industry, not only have they proved to be of the most intense importance in time of war, but they are likely to be of still greater potential value should we be faced with war in the future. But it is not only in the military sphere, or in that wide commercial sphere, that dyes enter, and enter at a key point, but in an extraordinarily interesting address delivered in this city last night there has been opened up a new vista of the possibility of the medicinal value of dyes. The industry thus carries a great responsibility upon its shoulders, and a great future lies before it.

There is one aspect of this Society which seems to me to be one of great value and of great promise. In it both the makers and the users of dyes meet on a common ground to study common problems and to pursue a common purpose. It is the *raison d'être* of the existence of those who make the dyes that they should adequately supply the needs of those vast industries which use them, and surely there can be no better course than that the best scientific brains in

ground such as this to develop their common problems, and to face their common difficulties.

The causes of our difficulties to-day lie in the fact of the poverty of the world resulting from the war. We have got now beyond the stage of visualising the wealth of the world on any artificial basis, and we know that the artificial prosperity experienced by many industries during the war came merely from mortgaging our resources—a necessary mortgage, and a mortgage which we were bound to give, but in every country of the world which was affected by the war, wealth was being spent in unproductive enterprise, and the wealth of the world was growing less. In the aftermath of the war, at the first, there was that sudden dectic hoom, which was inevitable perhaps but profoundly unfortunate, because an impoverished world was still further mortgaging its resources at unduly high prices; and following on that, with its inevitable slump, we see that in many quarters the resources of the world are still heing wasted in unproductive expenditure. That is the main basic cause of the difficulties in this country to-day, and until that cause is remedied the position can never become straight. It affects us everywhere. It affects those who live by our great export trade, in that the markets in which they sell their goods have the less capacity to buy directly. But the great mechanism of British commerce was not simply a mechanism of direct trade to and fro. It was far more complicated than that. It was a mechanism so complicated that I doubt whether one man in a thousand recognised all its inter-relations until with a crash, through the war, the whole machine was suddenly thrown out of joint, and because it ceased to run we saw its complexity. You find that to-day the markets which hought from you are unable to buy. Because Europe is unable to buy, India sends into Europe less than half of what she did before the war, and it was those very credits created by India in Europe that filled the workshops of Lancashire. That is the position. I am just trying to-night to talk the ordinary sound economic common sense that needs to be talked in every assembly, whether political or any other. The job of the statesman to-day, as I see it, is to create those conditions in which traders can carry on their trade. The most essential of those conditions are these. In the first place, the establishment of real and lasting peace all over the world by the development of the real will to prove the possibility to peace and the means to peace right through the whole world; to bring the whole conception of the Washington Convention into a world-wide reality which will react through all the countries of the world. The world is nominally at peace to-day, or the larger part of it. But you still find colossal armaments in many countries whose exchanges have gone to ruin and who are utterly unable to support those armaments. You will find the justification of those armaments in the fact that the nations are uncertain as to whether some attack may not come upon them from one quarter or another. If you could halve those military budgets you could largely abolish the inflated note issues. Not only that, but you would then have the will to peace in those couutries. You would have men setting their minds solidly to the work of reconstruction, and there is no way to build up the world except by the sweat of men's brows and the steady work of their brains. Peace is the first and the last essential, for with peace there is stability. Whether it is in statecraft, or in business, men want to know that when they enter upon an enterprise the course is clear right through to the end of that enterprise. That cannot be given by a hand-to-mouth settlement, nor a day-to-day settlement, but only by a finality on which men, whether politicians or business men, can hase their policy through the years to come. Depreciated exchanges are not the cause of all these difficulties. They are the inevitable consequence of the positions which exist in the world to-day. Therefore, the two objects which any man who claims to be even a politician, much less a statesman, should put before him are peace and certainty in economic conditions. But there is one other duty not less important, and that is to disabuse the minds of men of fallacies which grow and grow from day to day. First, there is the fallacy that there is any short cut to prosperity and to the redemption of the world. Then there is what I may call the fallacy of exclusive nationalism. The world has got to learn that an exclusive nationalism is neither practical, not patriotic, nor does it pay. We know that in our industries there is a complete interdependence of one industry upon the other. For example, it is not practical business for a nation which has neither coal

nor iron, to try to become a great iron and steel producing country. The economic future of the world demands the co-operation of the nations. Another fallacy is seen in the amazing way that people talk about credit. They talk about the possibility of creating credit as if it was merely a form of outdoor relief. Credit in the long run really means that the investor has got to come in, and out of his savings make his investments. To talk about the artificial creation of credit to people who have neither the capacity nor the will to pay is perfectly impossible. If credit is to be created, the conditions which breed credit have got to be there, and the investor has to be drawn in. Finally, another fallacy that has got to be combated, is that anybody is able to buy from you unless at the same time he sells. Buying power means one thing and one thing only. It means that the man who buys from you is producing, and he is able to sell his commodities, and through the general interchange system of the world is able to buy from you.

Obvious as it all is, how completely alien these simple observations are from much of the thought, or at any rate from much of the action, which is found nationally and internationally to-day. If the Genoa Conference, in which I have great faith, is able to achieve this, and this alone—that the world is persuaded not only to see the obvious but to do the obvious, then it will have achieved a signal service which no other Conference has yet achieved.

I have to couple this toast with the name of a very distinguished man and an old friend of my own, Mr. Sutcliffe Smith. There is no man who has rendered industry better service. I remember the service which he rendered to the Colour Users' Association when he assumed the chairmanship of that body at a not too easy time. I remember his work as President of the Bradford Chamber of Commerce, and more recently as one who has achieved a commercial entente for his industry with the French people in Houbaix and Turcoing, and for which the French people have rendered hi mhomage. I am not sure whether he or I have the greater claim to the complete reorganisation of export credits, but I am perfectly prepared to share on a fifty-fifty basis. I remember that to him is almost entirely attributable the establishment of an Austrian clearing office which is working effectively at the present time. He is the kind of man that we want in what I may call non-political public life to-day, and that is the kind of public life that is most important.

The President, in responding to the toast, extended to Sir Philip Lloyd-Greame, on behalf of the Society, a most hearty welcome. He proceeded:—I am sure that in saying how much we appreciate his address we can extend at the same time a very hearty welcome to him to the Industrial North. His work at the Department of Overseas Trade has been magnificent, and is appreciated not only by us, but also by the whole of the British trading public. We have also many other distinguished men here to whom we extend the same hearty welcome.

I had considerable diffidence in taking the Presidency of this Society after such a very distinguished man as the late Lord Moulton, whose death was a great and irreplaceable loss to all of us. But I feel highly honoured at being President, and being also Chairman of the Colour Users' Association; in my dual capacity I get a bird's-eye view o fthe many-sided interests, both scientific and practical, of the great dye industry, and the vital trades of this country to which that industry is so closely allied, and which, for their very existence, depend upon it.

The Society of Dyers and Colourists was originally formed in March, 1884, and its objects are purely scientific and technical. Its Journal, first issued in 1885, is known all over the world, and is of recognised scientific value. The past year has been an exceedingly busy one for the Society; the membership has been largely increased, and many meetings have been held by the various sections of the Society.

In Manchester you have wisely taken a great step forward in your Cotton Research Association, the headquarters of which was opened by H.R.H. the Duke of York on Tuesday last at Didsbury. I hope the Lancashire cotton industry, by its help, will continue to prove to the world that its productions are unexcelled for excellence and value.

The great hope of the future for British industry is that we should keep advancing by the aid of research, scientific methods, and economic production, thus placing our goods on a higher plane. It is only by doing this that we shall be able to meet the fierce competition that we inevitably shall

have to face in the markets of the world. I claim that no body has been more indefatigable in research than our Society, and it has been well said by one research authority that "we have delivered the goods."

Our work has been much appreciated by the Department of Scientific and Industrial Research as is shown by the fact that from 1917—1920 inclusive, they have allotted to us £1,125, and for every £1 so allotted the Society has put down a similar amount, and also an additional £914, making a total of £3,164.

This sum, although much too small for such an important work, has been, may I say it, very wisely and economically expended. We have lately been informed by the Department, we believe much to their regret, that they cannot see their way to continue this grant owing to the fact that they have had to divert their funds largely to the big Research Associations.

Now, gentlemen, I should like to appeal to the Department to reconsider their decision. The work is so important, that I feel it would he a great mistake to allow the scientific brains we have in this Society to lie dormant as regards research for what is, after all, a very small sum of money.

I venture to suggest also that the big dye-manufacturing firms, who have had large grants for research from the Government, might consider diverting a little of this money to enable our Society to continue this much needed work. May I also appeal to the Research Associations to consider whether it would not be highly desirable in their own interests to support this Society?

Then I should like to refer to the enterprise, lately undertaken by our Society, of issuing a much wanted colour index. The whole trade, makers and users alike, have so far had to rely for any information on the structure and properties of dyes on the out-of-date German colour tables issued in 1914. Great progress has already been made with this index, thanks to the initial enthusiasm of Mr. Hickson, and the very able services of Dr. Rowe, the Editor of the Colour Index, and his colleagues, and it is hoped to issue the first part in June, followed monthly by another, the whole to be completed in about twelve monthly parts. More detail will be given than in the Schultz book, and after leaving out obsolete colours there will be at least two hundred more colours described than appear in that book. As it will be issued in English, the previous difficulty of translating technical German will be obviated, and it is hoped to keep the book up-to-date by means of periodical supplements in the *Journal*.

This is a monumental work, which will prove of the most valuable service to the English-speaking world, and one upon which the Society can be heartily congratulated.

(*To be Continued.*)

CHEMICAL NOTICES FROM FOREIGN SOURCES

DETECTION OF FORMOL BY MEANS OF PHENOLS—*B. Pfyl, G. Reif, and A. Hanner.* —The alcoholic liquid in which methyl alcohol is supposed to be present is first oxidised with permanganate and filtered. If an alcoholic extract containing essential oils is under examination, the liquid is acidified with sulphuric acid, and distilled, and then infusorial earth is added, and the clear liqkuid is oxidised. Guaiacol is the best phenol to use for the test, a solution of 0.02 gr. in 10 cc. of concentrated sulphuric acid giving a red colouration with formol. 5 cc. of this solution are placed in a watch glass and about 0.1 cc. of the solution is to tested is added, and the colouration appears if 0.5 per cent. of methyl alcohol is present. Apomorphine hydrochloride gives a characteristic precipitate with formol, and the reaction is as sensitive as that with quaiacol. — (*Chem. Zeit.* XLV., 1921, 1,220.)

MERCURY FULMINATE—*H. Rathsburg.*— Impure mercury fulminate is much less stable than the pure product, and contains various unsaturated impurities. The impure product reacts more or less with potassium permanganate in aqueous solution in presence of acid or normal sodium carbonate, caustic soda and sulphuric acid, and with iodine and bromine in aqueous or sulphuric acid solution, while with the pure substance no reaction occurs. The pure product can be kept at a temperature of 50-60° for six months without undergoing any change, or it may suffer a loss amounting to about 0.5 per cent., while the corresponding loss of the raw substance in the same circumstances may be as great as 7.6 per cent. The raw fulminate, when dissolved in 20 per cent. ammonia and reprecipitated with acetic acid, may give up to this solution as much as 3.2 per cent. of oxalic acid.—(*Ber. deut. chem. Gesellschaft*, LIV., 1921, 3,185.)

DETECTION OF ARSENIC IN SOME MEDICINAL CHEMICALS—*J. Cribier.*—It has frequently been pointed out that arsenic may be present in various pharmaceutical products, and although the quantity may seem to be very small, the ill-effects of repeated minute doses must not be forgotten. The author's method of detection of such small quantities, involving the use of developed mercuric paper (*Journ. de Pharm. et de Chim.* XXIV., 1921 ,141), has enabled him to determine the amounts present in a very large number of chemicals used in medicine. If antimony, iron, or bismuth is present it is necessary to precipitate the ammoniacal magnesium phosphate in presence of tartaric acid, to prevent the precipitation of the hydroxides of these three metals. The sulphuric acid solution of this precipitate, which contains all the arsenic, can then be used for the exact determination of the quantity present. The examination of some hundreds of products shows that appreciable guantities of arsenic may be present in compounds of iron and antimony, and one specimen of calcium phosphate contained a relatively large amount.—(*Journ. de Pharm. et de Chim.*, XXV., 1922, 337.)

METHOD OF PREPARATION OF CITRATE AND TARTRATE OF BISMUTH—*Dr. Fabrègue.*—To prepare bismuth citrate, the author dissolves 100 gr. of bismuth nitrate in 200 gr. of acetic acid, dilutes with 500 gr. of distilled water, and filters. A solution of 67 gr. of sodium citrate in 600 cc. of water is then added. The white precipitate thus formed is allowed to settle and then washed with alcohol till the latter gives no residue on evaporation. The citrate is then dried at about 60°. It is a white micro-crystalline powder, insoluble in water, alcohol, ether and dilute acids, but soluble in ammoniacal water, with formation of double salts. Litmis paper is tinged red with it. Bismuth citrate has probably the constitution of an emetic. Its acid function enables it to form double salts with ammonium, the alkalis and the alkaline carbonates. The author has not succeeded in preparing double salts with ammonium or sodium, only getting more or less basic compounds when bismuth citrate in suspension in water was neutralised with ammonia or soda, and evaporated. Solutions of the double citrate of bismuth and sodium can be obtained by adding a solution of soda to the citrate till it was exactly neutral, but such solutions must be used at once, for they readily give a deposit of a basic salt. The addition of glycerine retards this decomposition, but does not prevent it. Bismuth tartrate can be prepared by an aualogous method, using sodium tartrate instead of citrate. These compounds can be used for intra-muscular and possibly for intra-venous injections.—(*Journ. de Pharm. et de Chim.*, XXV., 1922, 341.)

GENERAL NOTES.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

EXAMINATIONS: APRIL, 1922.—PASS LIST.

The following candidates passed the examination for the Associateship (A.I.C.):

In General Chemistry: Byrne, Lawrence James Patrick, B.Sc. (Birm.), University of Birmingham; Gardener, Guy William Carr, King's College, London, and Sir John Cass Technical Institute; Illing, Edward Thomas, B.Sc. (Lond.), Birkbeck College; Jones, Hugh Trefor, B.Sc. (Wales), University College of Wales, Aberystwyth; Raynes, John Leonard, B.Sc. (Lond.), University College, Nottingham; Shadbolt, Frederick Stanley, Sir John Cass Technical Institute and Birkbeck College.

In Branch (d), Organic Chemistry: Naylor, Henry, Blackburn Mnicipal Technical College; Philip, Reginald John, Birmingham Municipal Technical School.

In Branch (g), the Chemical Technology of Sulphuric Acid and its By-Products: Sanders, Alexander, Royal Technical College, Glasgow.

The following Associates passed the examination for the Fellowship (F.I.C.):—

In Branch A, section II., Metallurgy: Hargreaves, Frank, A.R.S.M., D.I.C.

In Branch E, the Chemistry (including Microscopy) of Foods and Drugs and Water: Barnes, Arthur Chapman, B.Sc. (Manc.); Byles, John Edward, B.Sc. (Manc.).

DETERMINATION OF SALT IN PETROLEUM.

Editor of the Journal of Industrial and Engineering Chemistry:

In the paper on the subject of "Determination of Chloride in Petroleum," by Ralph R. Mathews I have noted with interest his scheme of separating salt water

by mixing acetone and water with the oil under examination.

In this laboratory we have for several years been estimating salt after burning off an oil. For rapid control we weigh from 10 to 20 g. of a fuel oil in a dry nickel dish of about 250 cc. capacity, and heat the dish and contents over a Bunsen gas flame. When the oil is fuming thickly, the gases over the dish are ignited with the Bunsen flame, and the heating is continued until the oil fumes burn out. The Bunsen flame is withdrawn for a minute, 75 cc. of water are added, and the mixture is boiled vigorously for a few minutes. The dish is cooled in a vessel of cold water until cool enough to handle, and the contents are filtered and washed several times with water, scrubbing out the dish. After the addition of a few drops of 1:10 potassium chromate solution, the filtrate and washings are titrated as usual with standard silver nitrate, and the results are calculated to NaCl.

There is left in the dish a mass of charred matter which, after sufficient washing, does not retain more than traces of salt, and need not be completely removed from the dish before another determination is made. The dish does not get to a red heat while the oil is burning off, and the charred mass provides a means of protecting NaCl from volatilising. The nickel dish is not used for any other work.

If the oil contains an abnormal quantity of salt, it foams and spatters badly, and a lower flame is used for the first part of the heating operation.

Our specification on fuel oil for use in open hearth and forge furnaces does not permit the presence of more than 0.25 per cent. of salt. However, it is only rarely that we have met with samples of oil running as high as 0.10 per cent. On the other hand, in composite samples from bunches of ten carloads we have never found a total absence of salt. GEORGE T. DOUGHERTY.

American Steel Foundries, Chicago,
Illinois, April 20, 1921.

[Reprinted from the Journal of Industrial and Engineering Chemistry, Vol. 14, No. 1, page 80. January, 1922.]

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

The report described below has been published by His Majesty's Stationery Office for the Department of Scientific and Industrial Research. Copies, price 6s. 6d. (by post, 6s. 8½d.) may be obtained through any bookseller, or direct from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.

ON THE ELECTRO-DEPOSITION OF IRON.

By W. E. Hughes, B.A. (Cantab), Late Chief Research Chemist, Electro-Metallurgical Committee, Ministry of Munitions.

In view of the extended use of electro-deposition of iron for many industrial purposes, the Department of Scientific and Industrial Research has considered it advisable to issue the present bulletin which embodies the results of research carried out by Mr. W. E. Hughes, with the assistance of grants made by the Department.

The contents of the report are arranged under the following headings:—

Introduction.

Division 1.—*Descriptive.*

General note on the description of the deposits.

Series I. On the effect of temperature.

Series II. On the effect of current density.

Series III. *On the effect of mechanical* movement.

Division 2.—Theoretical.

Introduction.

I. The crystallisation of substances in general.

II. Application to electro-deposited metal.

A consideration of the results of the experiments of the series I., II., and III. Some remarks on deposits (1) from other iron solutions; (2) of other metals. General conclusions.

III. Workshop application.

Appendix. — Bibliography comprising references to publications on:—

I. The electro-deposition of iron and phenomena connected therewith.

II. The properties of electrolytic iron.

III. Works of reference relating to the electro-deposition of iron.

The bibliography will be of use to those desiring general information upon the subject, as well as to research workers. The report is copiously illustrated by a number of microphotographs.

THE GERMAN DYE TRUST.

In the House of Commons on April 26, Major Mackenzie Wood asked the President of the Board of Trade whether his attention had been called to the reported alliance between La Compagnie Nationale de Matières Colorantes et de Produits Chemiques, the trading makers of dyes in France, and the Interessin Gemeinschaft, the German dye trust, under which the Germans had agreed to assist the French company and disclose their trade secrets in consideration of the French undertaking to confine their sales to France and its colonies and to hand over 50 per cent. of their profits to the German trust; whether this arrangement had been communicated to the Reparations Commission; and what effect, if any, it would have on the delivery of dyes under the reparation clauses of the Treaty?

Sir W. Mitchell-Thomson, Under-Secretary to the Board of Trade, replied: I have seen statements to the effect that some agreement has been made between the French Company mentioned and the Interessin Gemeinschaft, but I have no official information as to its precise nature, and I am not aware that it has been communicated to the Reparation Commission. It does not appear that any such private agreement can have any effect on the delivery of dyestuffs under the reparation clauses of the Treaty of Versailles.

Major M. Wood: Is not the export of dyes' formulæ equivalent to the export of dyes, and does not that have a bearing upon the reparation clauses of the Versailles Treaty?—Sir W. Mitchell-Thomson: No, sir. I do not think so.—Dr. Murray: Is the hon. gentleman aware of the fact that Italy is contemplating a similar arrangement?—Sir W. Mitchell-Thomson: No, sir. I am not aware of that.—Mr. Kiley: Is he aware that the British Cellulose Company, in which the Government have a substantial interest, propose to engage a German staff,—No answer was given.

NOTES ON BOOKS.

Petroleum, by Sir Boverton Redwood, Bart. Fourth Edition, reset throughout. In 3 Vols. Vol. 1: pp. XXX. + 364. Vol. 2: pp. 365 - 740. Vol. 3: pp. 741 - 1,353. London: Charles Griffin & Co., Ltd., 1922. Price £5 5s.

This complete treatise on Petroleum will remain for ever one of the classics of technological literature.

The present thoroughly revised edition is the latest authoritative word on the subject. His scientific attainments and unique experience and knowledge of petroleum technology place everything on this subject from the pen of Sir Boverton Redwood on a very high level. But this edition also embodies the work of many other experts and specialists in various branches. This work thus becomes a most valuable encyclopædia on Petroleum.

Chemical research has extended our knowledge of the composition of the different mineral oils. The development of colloid chemistry has helped in the elucidation of problems connected with the refining of crude oils. Mechanical improvements have occurred in methods of exploitation and transport. The wider use of oil-consuming engines has given further impetus to this industry.

The refining and testing of the crude oils and their products is considered very fully, as are the uses to which these bodies are put. This section is thus of special interest to analysts.

From the scientific point of view, the section on the origin of Petroleum and natural gas has special interest. The various speculations and theories and the evidence on which they are based are given. It is almost certain that different deposits have originated differently. The Engler-Höfer dual theory had, at one time, the most adherents, but has lost favour of late among geologists.

Regulations in force in all parts of the world, relating to testing, storage, and transport, occupy nearly a hundred pages. Useful statistical appendices on import duties, etc., are included.

Finally, it must be mentioned that the numerous and comprehensive maps are exceedingly well done.

Sir F. Black's foreord constitutes a short biographical notice of the author.

This monumental work deserves the widest circulation it is possible for a technological treatise to attain. More than this can be said of no book.

J. G. F. D.

Ozone, by E. K. RIDEAL, M.B.E., M.A. (CANTAB), PH.D. Pp. IX. + 198. London: Constable & Co., Ltd., 1920. Price 12s. net.

Since its discovery, ozone has increasingly attracted the attention of chemists and industrialists. It has been of value as an aid to research and has already found considerable industrial application.

This volume is one of a series on Electrochemistry, published under the general editorship of the late Mr. Bertram Blount. The first chapters deal with the history, properties and occurrence of ozone, and are followed by a full description of the chemical, and especially the electrical methods of its production.

Among the industrial applications of ozone which are described, mention may be made of its use for hygienic purposes. It is used for sterilising water and purifying air, and also for bleaching fibres and oils.

Organic compounds containing ethylenic linkages unite with ozone, forming ozonides, which decompose into ketones, etc., on addition of water.

The probable existence of oxozone and oxozonides (Harries researches) is also touched upon. Various methods of detection and estimation are fully discussed.

The book is well illustrated, and should commend itself to those interested in this subject. J. G. F. D.

Dictionary of Explosives, by ARTHUR MARSHALL, A.C.G.I., F.I.C., F.C.S. Pp. XIV. + 160. London: J. & A. Churchill, 1920. Price 15s. net.

The author has endeavoured to make this reference book as complete as possible.

Firstly, explosives of different countries are classified according to their use. Then follow the descriptions of the various explosives, and finally there is a list of the separate ingredients.

The introduction contains, among other matter, remarks on the various nitro-celluloses.

The dictionary will certainly be useful to specialists. J. G. F. D.

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(1) *Zirconium and its Compounds*, by FRANCIS P. VENABLE. Pp. 173. Price $2.50.

(2) *The Vitamins*, by H. C. SHERMAN and S. L. SMITH. Pp. 273. Price $4. American Chemical Society Monograph Series. New York: The Chemical Catalog Co., Inc., 1922.

All branches of chemical science have developed to such an extent that it is difficult to keep in touch with the progress made in varied fields, and the American Chemical Society is to be congratulated on its attempt to found a chemical literature without regard to commercial considerations.

It intends to secure authors for monographs on subjects of current interest, and will critically examine their manuscripts. A high level has been attained in both volumes under review.

(1) Prof. Venable's investigations on Zirconium are well-known, and in this monograph he gives an account of the history, isolation, properties, compounds (inorganic and organic), and applications of this fairly widely distributed element. The silicate is found in Brazil, Ceylon and many other localities. Although this was known long ago, the preparation of pure zirconium has been very troublesome on account of difficulties encountered in the reduction of the oxide or haloids.

The amphoteric nature of the oxide enables a large number of compounds of this element to be obtained, and the number of technical applications of zirconium and its compounds is surprisingly great.

The list of patents and bibliography occupy 40 pages.

(2) The exact chemical nature of the vitamins has still to be elucidated. The authors of this monograph have ably summarised our present knowledge of these most important factors in nutrition.

The energy needs of the body are usually expressed in terms of calories, but the body is more than a heat engine, since the necessary carbohydrates, proteins and mineral matter may be consumed to meet all energy requirements, and yet the body will fail to maintain a healthy state. It lacks an "accessory factor."

It is now generally recognised that there are three Vitamins—"A," "B," and "C"—each functions in its own special way. The anti-neuritic Vitamin B is water-soluble, Vitamin C is anti-scorbutic, whilst Vitamin A occurs in most natural fats in which it is soluble.

Results obtained with diets deficient of one or more of these unidentified bodies are intelligently presented to the general scientific reader. The exhaustive bibliography will be found of value to biochemists and other investigators. J. G. F. D.

PLATINUM.

By George F. Kunz.

(Continued from Last Week).

Germany.—In relation to certain reported occurrences of platinum in the Siegerland and Sauerland districts of Germany, F. Beyschlag states, in the "Zeitschrift für pratische Geologie," that although exaggerated expectations exist as to the importance of these finds, based on inadequate and unreliable research methods, the presence of small quantities of the metal appears to be well established. The platinum occurs in an irregular and hitherto unconcentrated form, but the writer thinks there is good reason to hope that in time secondary concentrations will be met with, or that improved methods will be devised for utilising the irregularly distributed material.

In the long list of raw materials needed in Germany last September, and submitted by the German Government to the Reparations Committee, appear 150 kilos, or 4,822 troy oz., of platinum. A part of the sum due for the great amount of foods and raw materials specified in the German request is to be paid for out of the initial 20,000,000,000 marks (nearly $5,000,000,000)- constituting the first instalment of the immense indemnity imposed upon Germany.[1] This platinum would be worth about $350,000 and perhaps more than that.

Russia.—A thoroughly trustworthy record of the early Russian production of platinum has been preserved for us.[2] In the 16-year period running from 1823 to the end of 1839, the official Russian returns give the platinum output as follows:—

	Poods.	Pfunds.	Zolotniks.	Doli.
From Crown Mines	29	—	83	82
From Nizhni-Tagilsk	1,216	29	91	36
From other private mines ...	13	13	65	10
Totals	1,259	4	48	32

Turned into grams and troy ounces this gives:—

	Grams.	Troy Ozs.
From Crown mines	475,392	15,282
From Nizhni-Tagilsk	19,930,924	640,722
From other private mines	218,547	7,026
Totals	20,624,863	663,030

At the present ruling price of platinum this would have a value of about $40,000,000, estimating that the grade was 83 per cent.

From 1887 to 1913, Russia is said to have produced 7,837 poods' weight of platinum (4,127,318 troy oz.), and to have exported platinum weighing 6,428 poods, or 3,385,275 troy oz. This export was divided among the principal importing countries in the following proportion: France, 70.09 per cent.; Germany, 29.13 per cent.; England, 0.78 per cent. Of course, a good part of the refined platinum was in turn exported by France and Germany, mainly by France. As to the amount of platinum still remaining in the explored mines, we are told that it can be put at about 7,000 poods, or nearly 3,700,000 troy oz.

From time to time a little information as to the present Russian platinum production leaks out. Thus the London *Financial World* reported not long since that about 400 poods' weight of the metal had been mined in the Urals in 1920.[1] This would mean a production of 210,646 troy oz., which, under existing circumstances seems hardly possible. It is also stated that in the refining factory in Moscow there was secured 54 poods, or 28,436 oz. of platinum, and 3,000 poods, or nearly 1,600,000 oz. of silver.

Concerning the reported discovery of new platinum deposits in the Petshora region of the Urals, B. Simmerbach, of Wiesbaden, Germany, in an article contributed to the publication *Edelerden und-Erze,* writes that, from his personal knowledge of the district, there can be no doubt that platinum and gold are to be found in the northern part of the Urals, notably in the Pakoi region, as well as in the Petshora district, and it is his conviction that an adequate survey will reveal the existence of very valuable platinum ores here.[2]

[1] *Min. Jour.*, Nov. 6, 1920.

[2] Schriften der Russich-Kaiserlichen Gesellschaft für die gesammte Mineralogie.

[1] From Dobrokhotov's "The Urals."

[2] [illegible]

Osmiridium in Russia has been obtained exclusively in the Urals, from the Miass district of the Orenburg Government, and in the North Ekaterinburg district of the Perm Government,[1] although in the last-mentioned district the mining of this metal has been abandoned. The annual production had decreased rapidly within the 12 years from 1902 to 1914, with a very slight recovery after 1912. In 1902 about 231¼ troy oz. was produced, the production falling by rapid stages to a little over 2½ oz. in 1912. In 1913 about 8¼ oz. was obtained, and in 1914 a trifle over 10½ oz. The total for the twelve years was 906 oz.

South Africa.—A number of valuable platinum fields have been discovered in the Cala district of Cape Colony, South Africa. Regarding these deposits, which are situated in the Transkei, Dr. A. Heymann writes that the metal comes principally from the basic rocks, which are rich in magnesia, and is generally found in beds of sand or clay, which have been formed by the disintegration of the original platiniferous deposits.[2] In these alluvials, or placers, as they are called, the metal occurs as flakes or grains, one of the chief impurities being titanic iron. Diorite, olivines and quartzite are constituents of the deposits. As compared with the Ural deposits, those of this African region were found to lie nearer the surface, and the platiniferous strata appeared, as far as the tests went, to be even thicker than those of Russia. Regarding the deposits at Red Hill, it is stated that a decomposed rock, found at the surface, assayed 0.75 dwt. (18 grains) of platinum to the ton; at a depth of 4ft. there was an average of 3 dwt. (72 grains = 0.15 oz.),[3] while samples taken from a depth of 4 to 6 ft. gave as much as 16.25 dwt. (or about 0.8 oz.) per ton. Other samples, taken from five different localities, gave respectively 14.4, 30, 39.6, 42, 44.4, 63.6, and 297.6 grains, the latter being equivalent to 0.625 oz. per ton.

The deposits are owned by the African Platinum Mines, Ltd., and this company is asserted to have the backing of several large concerns in Capetown. The capital of the company is reported to be £150,000. In the new platinum field there are said to be large areas where platinum occurs in small quantities, but there are also sectional zones of concentration.

In connection with the discoveries of platinum in the Cala district, it has been already noted that for several hundred miles along the margin of the Bushweld granite area in the Transvaal, pseudostratified segregations of chromite, associated with platinum, have been noted.[1] These formations are several feet thick, and are said to be quite workable, although, as yet, they have not been exploited.[2] In the copper-nickel deposits of Insigwa, Cape Province, platinum has been found in quantities ranging from 12 grains per ton to nearly 5 oz. per ton. However, this distribution is very irregular, but in any case should the deposit be worked for its copper content, the associated platinum would constitute a valuable by-product.

Spain.—The platinum deposits in the Sierra de Ronda, in southern Spain, occur in an enormous outcrop of peridotites, with rhombic pyroxene dominating, surrounded by a border of gneisses metamorphosed in contact with the peridotites. The gneisses, débris of the ancient covering, are also to be found in the interior of the peridotic mass, and here also the contact of the peridotite and the gneiss is direct. It may be added that the forms of erosion of the peridotites offer no analogy with those of peridotic centres i nthe Urals. In the alluvial deposits the disposition of the platinum in the alluvial covering differs absolutely from that observable in the Urals. In the Spanish deposits the platinum, as is frequently the case with very recent auriferous alluvials, appears to be more or less regularly disseminated through the entire depth of the formation. In the Urals, on the other hand, the platinum, at least the industrial platinum, is exclusively concentrated in the layers of compact gravel, often argillaceous, termed *peskis* in Russia.

[1] *Comm. Rept.*, Oct. 28, 1920, prepared by the Russian Division of the Bureau of Foreign and Domestic Commerce.

[2] *So. Afr. Min. Eng. Jour.*, Dec. 18, 1920.

[3] *Idem.*, Sept. 4, 1920.

[1] *Idem*, Sept. 18, 1920.

[2] *So. Afr. Min. Eng. Jour.*, Sept. 18, 1920.

(*To be Continued.*)

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

10203—Elektrizitatswerk Lonza.—Manufacture of aldol from acetaldehyde. April 10.

10183—Metz, H. A.—Complex arseno-stibino compounds, and process of making same. April 10.

10699—*Rupprecht, G.—Process for treating plant* culture with sulphur. April 13.

10528—Techno Chemical Laboratories, Ltd.—Recovery of heat from treated material. April 12.

Specifications Published this Week.

153,290—Norsk Hydro-Elektrisk Kvaelstofak-Tieselsakh.—Catalyzer for the synthetic manufacture of ammonia and process of producing same.

156,138—Trauns Forschungs: aboratorium Ges, H.O.—Process for the manufacture of plastic masses.

156,146—*Trauns Forschungs: laboratorium Ges,* H.O.—Process for the oxidation of acet-*aldehyde to acetic acid.*

156,148—Trauns Forschungs laboratorium Ges.—Process for the manufacture of formaldehyde and methyl alcohol.

157,966—Grpsse, L. C.—Dry method of purifying gases and vapours.

Abstract Published this Week.

Dialkyd sulphate.—Patent No. 175,077.—Messrs. *The British Cellulose & Chemical* Manufacturing Co., Ltd., of 8, Waterloo Place, London, have patented a process for obtaining Dialkyl sulphate by distilling alkyl hydrogen sulphates or mixtures containing them in vacuo, so that only the small portion of liquid actually undergoing distillation is heated, and so that the vapours and residue are rapidly removed from the point at which distillation *occurs. For example,* the liquid containing alkyl hydrogen sulphate may flow in a thin film over a heated surface, or down a heated coil or tube, or may be sprayed into the still or carried into the heated zone by a revolv*ing drum or moving* band. In an example a mixture of ethyl alcohol and fuming sulphuric acid is caused to flow, by means of a revolving office down the inside of a vertical heated tube connected to a vacuum and condensing system; diethyl sulphate separates from the distillate, the remainder, consisting of alcohol, sulphuric acid, etc., being utilised in the next operation. Dimethyl, dispropyl, dibutyl, etc. sulphates may be similarly prepared.

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CHEMICAL SOCIETY RESEARCH FUND.

A MEETING *of the Research Fund* Committee will be held in June next. *Applications for Grants*, to be made on Forms which can be obtained from the Assistant Secretary, Chemical Society, Burlington House, W.1, must be received on or before Thursday, June 1st, 1922.

All persons who received grants in June, 1921, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be returned by Thursday, June 1st.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

PHENOL PRODUCTS.

THE PROPRIETOR of British Letters Patent No. 9291, of 1914, is prepared to sell the Patent or to license British Manufacturers to work under it. It relates to an improved method of manufacturing condensation products of phenol and substances containing the methylene radical.

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THE CHEMICAL NEWS,
VOL. CXXIV., No. 3240.

THE SOCIETY OF CHEMICAL INDUSTRY—MANCHESTER SECTION.

FROM OUR OWN REPORTER.

"THE PROGRESS OF VEGETABLE OIL EXTRACTION,"

BY R. A. BELLWOOD, M.I.M.E.

The Eighth Meeting of the Manchester Section was held on May 7th, Dr. E. Ardern presiding.

Mr. R. A. Bellwood, of Hull, read a Paper entitled "The Progress of Vegetable Oil Extraction."

The Paper deals entirely with the extraction of oils by pressing machinery. Mr. Bellwood said that although it was known from the Old Testament that the Israelites had knowledge of oils, yet there is no reference to the appliances they used. It is, however, learned from the early writers that the winning of oils technically was known to the Egyptians, from whom the Israelites, in all probability, received their knowledge of the practice. It is believed that the Egyptians knew of the expressing of oils at least 5,000 years ago, and an illustration of a press for extracting juice from grapes is shown in Wilkinson's "Egypt." This press consisted of a strong wooden framework and a stout stuff bag, containing the material to be pressed, suspended horizontally between vertical posts, which were subjected to a wringing and squeezing pressure which brought out the liquid contents. In all probability the same kiud of press was used for the expression of oils from olives. Vetrurius, in an article written two or three thousand years ago, mentions oil presses witn very long levers. Pliny (23 A.D.) gives a description of an oil mill consisting of a set of stones for grinding olives, these stones being somewhat similar in appearance to those used at the present day. The stones were convex on the face instead of flat, as now used. A centre shaft or axle passed through the centre of the stones, which were dragged round by slaves. The olive pulp was taken from the stones and put into sacks made of woven rushes, and then place dunderneath very heavy flat stones, which were lifted by means of levers, so that the olives could be placed heneath to receive the pressure, or taken away when the pressing process was complete.

The ancients, generally speaking, used what is usually known as the "pestle and mortar" press. Like Herbert, a civil engineer, in an article published in the Engineers' and Mechanics' Encyclopædia in 1863, made the statement that he had been so forcibly impressed with the defects of the "pestle and mortar" press that he had designed a few years previously a more powerful machine, in which the combinations were few and of a simple character, and easily made by the roughest workman at a trifling expense. He asked the reader of the encyclopædia to bear in mind that the press was designed for the rural expression of oil on the spot where the seeds grew. Several writers had wrongly attributed the invention of Luke Herbert's press to the ancients.

It is difficult to decide what form of press followed the ancient lever press, but in all probability it was a crude form of the "pestle and mortar" press. The mortar was built out of the trunk of a tree, with a lining usually made of boxwood. There was a long paw which was used as a pestle, and this was given a rolling motion by means of a rope arrangement and bullock power.

A modified form of the "pestle and mortar" apparatus is commonly in use in India and China, and Mr. Bellwood produced an actual cake made in one of them. A typical installation, shown upon the screen, was made pre-war for £20. This was an indication of the difficulty facing English engineers when competing with native labour.

In all probability the "wedge" press followed, or was contemporary, though its use, apparently, has now been discontinued. When using the "wedge" press, the seed was first ground under stones, and a form of stone which is used even to-day in some parts of China was exhibited upon the screen. There was only one stone, with a small diameter and very large face. The seed was passed into a feeding box by means of a small slide. The power was supplied by bullock or horses. The ground seed was taken away from the stone in a riddle closely resembling those used by housewives to-day for riddling cinders, and placed on the top of a copper similar to that used to-day for clothes washing purposes. Steam was evolved from the cop-

per, moistening and tempering the seeds, being practically the same process adopted in modern oil mills. After tempering, several measures of the meal were placed in a bag made of straw, the whole again being put in a container arranged below two heavy beams. Pressure was applied to the material by means of a long wedge arranged between the two beams, so as to force them apart. The wedge was driven in by means of a heavy hammer suspended from the ceiling. Near the bottom of the container there was a pipe arranged to carry away the oil.

Stamping mills were used in the 10th century for crushing oil seeds, and Zeisung describes an oil mill of this type. The "sledgehammer" press was improved by the Dutch in the 17th century. They introduced a "stamper" press which was not used for crushing the seed, but which was actually a press. In the early Dutch mills the seed was crushed under upright, revolving stones. It was heated in pans over an open fire, and the oil was then expressed by means of the stamper wedge press. The Germans, as is their wont, claimed the credit of first producing the vertical type of stamper-wedge press, but there is no doubt that it was the Dutch who introduced it into England. These stamper mills were almost entirely built of wood, and the workmanship reflected great credit on the old millwrights.

An illustration was shown of an early Dutch mill which was running about the year 1790. The power was supplied by a wooden waterwheel of about 18 ft. diameter and 4 ft. wide. A pair of cast-iron rollers crushed the seed before it went to the stone. The frame, driving shaft, wheels and stamper were made of wood. Stamper mills driven by water power were installed at Liverpool in 1804.

In 1858, Alexander Samuelson, of Hull, a manufacturer of oil machinery, gave a lecture before the Society of Mechanical Engineers, which is reported in Spon's dictionary, and described an old type of stamper press which was in use in this country until 1860.

It is believed that stamper mills were in existence in Hull at the end of the 17th century, and it is known that there were at least two of these mills at work in 1810. They were superseded by the hydraulic press, which was made possible by Bramah's invention of the "U" Ram Leather. This invention revolutionised the oil-milling industry. It is difficult to say with certainty when the first hydraulic press was made for use in oil-mills, but it is generally believed that in England it was about 1814, in Germany about 1818, and in France about 1819. They were in use in Hull about 1830. A press was made by Mr. Bramah, and sent out by the British Government to Ceylon, for the purpose of expressing oil from coconuts. The hydraulic press did not gain the confidence of the public as quickly as it should have done. A number of other developments occurred including the introduction of the steam-heated kettle. It is not definitely known when the idea of steam jacketing the kettle bottom was first mooted, but it was after the year 1787, because Smeeton then took out a patent for cooking kettles, which he described as being heated by water or sand.

A Mr. Blundell, of the firm of Blundell, Spence & Co., colour manufacturers, is credited with being responsible for the design of the "Four-box" hydraulic press, and he introduced it into his mill at Hull about 1830. Among the earlier manufacturers of this press were Whitman, of Leeds; Rose, Downs, Thompson & Co., of Hull; and Alexander Sanderson & Co., of Hull. It was first introduced in Liverpool about 1845. The style of hydraulic pumps used in those times is still in vogue. The diameter of the press ram was 12 inches, the stroke was about 10 inches, and the press was fitted with four boxes, and received four bags of seed, producing a weight of 64 lb. of meal, or cake, at each operation. Samuelson describes the seed as being carried to the press in canvas or hair bags. In 1847, James Robson proposed the substitution for hair cloths of an instrument which was constructed of two metal perforated plates.

Smeeton improved the operation of roller mills by making the rolls of unequal diameters. Practically no variation had been made in the type of "edge runner" stones. W. E. Newton, in 1856, patented a device for the continuous feed of material to the stones, with an arrangement of sweepers whereby it was taken away gradually as it was ground, thus rendering the process quite automatic. This same principle was in use to-day in many of the larger oil mills in this country.

It has been generally understood that the idea of using a press with a number of supported plates, and a moulding machine to give the prepared meal a preliminary compression, dated from the year 1874. To use a common expression, "there is nothing new under the sun," and this was found to be so by Mr. James Downs, of Hull, who, in 1874, patented a press for extracting oil from seeds, and which entirely superseded the "four-box" presses. It consisted of a series of wrought-iron plates, upon either side of which is riveted, or otherwise fixed, preferably, corrugated plates. Each press was made to take 16 cakes instead of four as with the existing box presses.

The "Cheeseborough" patent, taken out two years before that of Downs', also had 16 plates. It is rather peculiar that these two people, who knew nothing whatever about each other, should have arrived at a similar result.

For 16 years a great invention had lain dormant. In 1856 a patent was taken out in the name of W. E. Newton, upon a communication from abroad. The patent does not state where the communication came from. Newton describes, and claims for, a cake-moulding machine and a cake press for making 16 cakes at one pressing. Thus, the 16 cake pressing machine existed in substance and in fact. It is almost inconceivable that for 16 years an invention of that kind should have lain dormant, and that all that time this and other countries should have been struggling with the old "four-box" press.

The first mill built on the "Anglo-American" system was put up by Messrs. Rose, Downs & Thompson, of Hull, for Messrs. Willows and Holt, in 1874, and had eight presses. There was also a mill built in the same year for Pearson Brothers, of Gainsborough. It is doubtful which of the two mills ran first. In 1878, Edward Ross Walker took out two patents which may be classed as notable improvements. In one patent he employed a hydraulic accumulator, which was to be worked from a larger or low-pressure pump, and a larger number of presses could be operated with the one pump. The hydraulic moulding machine invented by Ross Walker had a spring head which permitted the seed to fall from its box.

The invention of the "Anglo-American" press naturally brought a great many improvements in its train, as the auxiliary machines hitherto used in connection with the box presses could not deal with the larger output. The grinding machine which is known as the "Anglo" roll was introduced. This consisted of several cast iron rolls placed above each other, having an average of about 16 inches diameter. With an up-to-date set of rolls the operator can see exactly what feed is passing between them. Larger cooking kettles were also employed, and arrangements made for transmitting the seed more quickly from the kettles to the moulding machine, while greater attention was paid to the heating and tempering of the seeds.

An illustration of an automatic machine used in the larger mills was then shown. It served 12 presses, and was made by Greenwood and Batley, of Leeds. The 12 presses could be quite easily worked by one man. The automatic "Anglo-American Cake Paring Machine" was practically independent of the workman in regard to its operation.

A cinematograph film showing the method of operating modern oil mills and their machinery was then shown.

Mr. Terleski moved, and Dr. Callan seconded, a vote of thanks to Mr. Bellwood for his lecture.

THE CHEMICAL SOCIETY.

Informal Meeting.

An Informal Meeting was held on Thursday, May 18th, 1922, following the business of the Ordinary Scientific Meeting at 8 p.m. A selection of autograph letters from the Roscoe Collection and of books of historical interest from the Library was exhibited.

DETERMINING SULPHUR DIOXIDE.

By G Basil Barham, M.Inst.M.

One method of determining the presence of sulphur dioxide which has not as yet been used either in the laboratory or in commercial operation, is to expose a piece of the so-called "rustless" iron to the action of the suspected body, sulphur dioxide being the one compound which will attack a silicon-iron alloy eagerly. A better method is that of titration with potassium permanganate, 0.005 N potassium perman-

ganate being the best strength to use. Messrs. Sweeney, Outcault and Withrow state that one drop of this corresponds to 0.000009 gramme of sulphur dioxide, the low normality making it possible to ensure great accuracy, but they point out that a much stronger solution should be used for a large concentration of SO_2. In a method used by them, the solution was prepared by diluting the laboratory stock solution, which was standardised with purified sodium sulphite after being allowed to stand for several days. (*Journ. Ind. and Engng. Chem.*, Oct., 1917.)

It has been shown in actual operation that the advantages of potassium permanganate over iodine for determining sulphur dioxide are that whilst it is as easy to prepare, it can be more easily manipulated and gives as great accuracy; it can be used on either large or small amounts; it requires no simultaneous blank, and so cuts down the amount of apparatus to be transported; is more stable to light, and gives a colour as easy or easier to match than the starch-iodine end-point. The permanganate must always be present in excess, for which reason it is impossible to titrate the sulphurous acid directly. There was, however, a scheme described in the findings of the Selby Smelter Commission, which gets over much of the difficulty, and with this is a certain amount of the potassium permanganate is run into dilute sulphuric acid, and as soon as the mixture is effected it is divided into two equal portions. The sulphur dioxide is then dissolved in one of the parts, and by means of a burette standard permanganate is added until the colour of the two portions exactly matches. The amount added is sufficient to oxidise the sulphur dioxide and still be in excess. According to a record of experiments made by the authorities quoted, the best colour to match is produced by adding 10 cubic centimetres of approximately 0.005 N permanganate to 490 cubic centimetres of water. After the permanganate is reduced, the colur on back-titration may not, and generally does not, match to original, but has a slightly reddish tinge. They say, however, that if the solution is reduced and oxidised once or twice before it is divided, little difficulty will be found in matching the colour exactly.

From 25 to 50 cubic centimetres of sulphuric acid (2N) should be in the solution, as less than this amount will give a red solution which cannot be matched easily whilst a surplus will act on the permanganate. Prolonged tests show that when any considerable amount of sulphur trioxide accompany the SO_2, the best plan is to use 25 cubic centimetres of the double normal acid. It has been found that the reaction is complete in the cold, and the titration is made at ordinary temperature. Merely shaking the permanganate solution in the sample bottle, free from sulphur dioxide, causes no loss of colour, consequently there is no need to run a blank, but only to match colour accurately.

Regarding the apparatus used, this consisted of a bottle or carboy holding at least 24 litres, fitted with a properly cleaned, two-holed rubber stopper with large stopcock and a plug, to be used as a sample bottle; together with two 500 cubic centimetre bottles of uniform clear glass for titrating, these being quite clear and free from "waves" to facilitate the colour matching. One of these should be provided with a two-holed rubber stopper containing a glass tube which will reach to the bottom. Other requirements are a white background; a 25 cubic centimetre burette; a 1,000 cubic centimetre bottle for diluting and mixing the solution of permanganate; a suction pump for emptying the sample bottle, and a manometer tube or gauge for obtaining the amount of evacuation. It is added that for very accurate work two Nessler tubes should be provided.

In practical work the sample bottle is evacuated, the internal pressure carefully noted, and a note taken of the temperature. The end of the tube in which is the stopcock is then placed in communication with the source of the gases to be analysed or with the flue through which they are passing, and the stopcock turned on and left in that position for a few moments until the sample bottle or carboy is completely filled; should this stopcock be closed too quickly there is a real danger that the gas may be attenuated, and although it is a simple matter to calculate the volume present, there is no reason why care should not be taken to see that the sample hottle is properly filled. For the purpose of determining the amount present the stopcock is closed and the temperature and barometric pressure ascertained, from which data the calculation is simple.

After measuring out about 475 cubic centimetres of water and putting them in the

1,000 cubic centimetre bottle, 30 cubic centimetres of 2N sulphuric acid are added, and after an interval, 10 cubic centimetres of standardised 0.005 N potassium permanganate are poured in. After mixing, the solution is divided equally in the two 500 cc. bottles. To one of these bottles sodium sulphite solution, or sulphurous acid, is added until the colour is faint, after which it is roughly restored by adding fresh permanganate. The solutions are now mixed and again divided; the burette is filled with standard permanganate solution, and the position of the meniscus noted. Mr. Sweeney then added such an amount of the solution to one of the bottles as would prevent the sulphurous acid from decolourising the solution, supposing the gas to be present in such proportions as would render this likely to happen.

The two-holed rubber stopper and tube are then placed in the permanganate bottle, the gas sample bottle is inverted, and the free end of its stopcock placed through the free hole of the permanganate stopper. When the stopcock is opened, the solution runs into the sample bottle as soon as the plug is removed, and in this connection several methods, such as bending the stopcock tube and placing the sample bottle on its side, can be adopted for convenience and to save undue handling. The sample bottle is then agitated for a time—a fairly simple method of dealing with this sample bottle would, in the writer's view, be to either place it on a couple of rockers capable of being scotched when required, or to fix it in gimbals—and the solution is then run back into the small bottle from which it was taken and titrated with permanganate until the colours of the two portions approximately match. It should then be run again into the sample bottle and agitated, and then run out into the small bottle again and very carefully matched for colour. This will have to be done against the white background mentioned and, as Mr. Sweeney points out, for very close work the Nessler tubes can be used. The total amount of permanganate run from the burette gives the amount of sulphur dioxide in the sample, and it will be seen that the details of manipulation are, broadly speaking, the same as those which were worked out so thoroughly for the iodine method by the Selby Smelter Commission.—(Bull. 98, U.S. Bureau of Mines.)

GENERAL NOTES

Watts's Index of Spectra Y. has now been published, containing data for *Iodine* and *Iridium*, and can be obtained from Mrs. Marshall Watts Ingleboro, Victoria Avenue, Southend-on-Sea, 7s. post free.

We understand that the Automatic and Electric Furnaces, Ltd., have introduced a marine-type of Wild-Barfield Electric furnace for use on board ship.

We learn from a pamphlet that has been forwarded to us from the University of Kansas that the study of Dietaries upon sound scientific lines has been started in some of the State institutions, with the object of determining *whether the food supplied is suitable, whether cheaper or other forms of food could be substituted with advantage*, and many other points of importance. The foods used with their protein, fats, carbo-hydrate, and calorific values are tabulated. We note with some interest that the list of foods used in the Penitentiary at Lansing contains ducks, oysters, peaches, radishes, cucumbers! They appear to live fairly well in the prisons of Kansas.

TEMPERATURE CARBONISATION.

The various views put forward at the conference recently held by the South Wales Institute of Engineers regarding low temperature carbonisation are summarised, and apear in the *Manchester Guardian Commercial*:—It is not easy to give an exact definition of the term, "low-temperature carbonisation" of coal. High-temperature carbonisation consists in heating raw coal in closed retorts or ovens at about 1,600-2,000 deg. F. In the gasworks process the main object is the production of as much gas as possible, and in the coke oven to obtain a hard metallurgical coal. Both these processes result in the decomposition of a large portion of the volatile matter of the coal into gas. The object of low-temperature carbonisation may be said to be to obtain the maximum yield of valuable liquid products from the volatile matter, to reduce the gas yield to a minimum, and to obtain a residual fuel which, while being smokeless like coke, will be easily ignited and suitable for a household fuel. Dr. Lander, of the Fuel Research Board,

gave as his opinion that the answer to the question, "Will it be possible to establish on sound industrial lines a new industry based on the carbonisation of tens of millions of tons of coal per annnm?" was that "the knowledge and experience which had been gained as the result of much patient work during the past few years have brought the answer almost within reach." If the problems of low-temperature carbonisations are solved it means a revolution in industry. Great Britain raises 250,000,000 tons of coal per annum and consumes at home 187,500,000 tons, of which 20,000,000 tons are used for coke ovens, and 18,000,000 tons for gasworks. If the remaining 149,500,000 tons were submitted to low-temperature carbonisation we should have available about 500,000,000 gallons of motor spirit (more than twice our consumption of petrol), 75,000,000 barrels of oil, and 1,350,000 tons of sulphate of ammonia. The total national saving would be over £250,000 per annum, including the complete abolition of black smoke and practical independence of the rest of the world for liquid fuel and fixed nitrogen."

GERMAN DYES.

In the House of Commons last week, Mr. Waddington asked the President of the Board of Trade whether any increases had recently been made in the price of German dyes for qualities not produced in this country; whether for German dyes of qualities which could be efficiently produced in this country the prices were being reduced; and whether he had any information that certain leading textile dye users in this country recently visited Germany and recommended German dye-makers to artificially reduce the price in this country of German dyes which competed with similar British dyes?

Mr. Baldwin replied: I understand that the German Dye-Stuff manufacturers have recently raised their prices generally, but that when dyestuffs equivalent to their products are put on the market by British manufacturers, it is their practice to reduce their prices in an attempt to undercut the British producers. As regards the last part of the question I have no doubt that some British consumers have sought to obtain specially low quotations from Germany.

Mr. Gratton Doyle asked the President to give a return of the quantities of dyestuffs admitted by the licensing committee appointed under the Dyestuffs Act of the quantities which had been refused admission, and of the particular exporting countries in each case?

Mr. Baldwin replied: Particulars of applications for licences which were granted or refused during the year 1921, and the months of January and February. 1922:—

	Granted.	Refused.
	lbs.	lbs.
From Switzerland ...	2,138,171	610,755
Germany	796,215	991,894
Other sources	216,455	268,568
Total	3,150,841	1,871,217

Captain Wedgwood Benn asked whether, seeing that the London memorandum of the experts states that the limitation of import should be effected by the medium of Customs duties rather than by a system of prohibition modified by licences, an amendment to the Dyestuffs Act was to be introduced by the Government?

Mr. Bridgeman replied: The answer is in the negative. Dyestuffs constitute one of those special cases which the memorandum expressly contemplates.

Mr. Hilton Young informed Mr. Ormsby-Gore that the total amount received to date by way of dividends on the Government's investments in the British Dyestuffs Corporation was £133,025 4s. 5d. A payment of £54,600 on account in respect of interest and sinking fund for the year ended the 30th June last had been made by the British Phosphate Commissions to the Exchequer. No return had been obtained from the investments in the British Cellulose Company.

Sir William Barton asked the President of the Board of Trade whether his attention had been called to an application made by W. T. Alexander, of 6, Brown Street, Manchester, for a licence to import a small quantity of algole 5G powder; whether he was aware that the applicant was informed by the licensing committee that a similar product could be obtained from the British Dyestuffs Corporation, Limited, from whom he obtained a sample; whether the Board wa saware that this sample was tested by the actual consumers, who reported direct to the licensing committee that the proposed substitute was not so pure and rich in tone as algole 5G, and that its properties as regards fastness were not so good;

reckoned on the basis of price per lb. and tinctoral value was more than three times that of the colour asked for, and that the consumers in question had no desire to get colour obroad if they could be reasonably supplied at home; and whether, the facts being as stated, he would give instructions to grant a licence?

Mr. Baldwin replied: I have made enquiry into this case. The Advisory Licensing Committee have investigated the quality of the British product and are satisfied that in this respect there is no sufficient reason for the grant of a licence. As regards price, the consumers concerned have been asked to furnish the Committee with certain information, on receipt of which the matter will be further considered.

Replying to Major Barnes, who asked whether his attention had been drawn to a statement to the effect that the leading French dyestuffs company, La Compagnie Nationale de Matieres Colorantes et de Produits Chimiques, had come to an arrangement with the German dye trust, the Interessen Gemeinschaft, whereby, in return for the disclosure of German dye secrets and technical assistance, the French company undertook to confine their sales to French dominions and to pay to Germany half of their profits; and if he could say whether a similar arrangement was contemplated between the German company and British Dyes, Limited, Mr. Baldwin, President of the Board of Trade, said:—As regards the first part of the question I would refer my hon. and gallant friend to previous answers. As regards the second part, I have no reason to suppose that an arrangement between the British Dyestuffs Corporation and the Interessen Gemeinschaft of the kind indicated is contemplated by the former.

BRITISH CELLULOSE COMPANY.

Mr. Neil Maclean asked the Secretary to the Treasury whether the British Government held £1,450,000 preference shares in the British Cellulose and Chemical Manufacturing Company; whether this company had lost over £1,000,000 during the last two years; whether a scheme for the reconstruction of the company had been submitted providing for a holding company with £500,000 capital running the business; whether the British Government had agreed to assist this scheme by giving the new company £750,000 preference shares; whether the market price of those shares when this arrangement was made was £166,250; and whether, seeing that this action had been agreed upon without consulting the House of Commons, its consent would be asked for before those shares belonging to the British Government were given away for nothing to a private company?

Mr. Hilton Young replied: The answers to the first four parts of the question are in the affirmative. For the full statement of the position I would refer the hon. member to the statement made by the Chairman of the Company at their general meeting on Monday last. As regards the fifth part, the shares, except in very small numbers, were practically of no realisable value at the time of the agreement to surrender a part of them to the parties furnishing the additional capital required to prevent the company going into liquidation. The answer to the last part of the question is in the negative.

GAS POISONING.

In answer to Sir Robert Clough, who asked whether his attention had been called to the frequent cases of poisoning by carbon monoxide gas; whether he had seen the statement that this is apparently due to the new type of gas manufactured; and whether, in any event, he would investigate the frequency of these cases so as to reassure the public and avoid, if possible, any further recurrence, Mr. Baldwin replied: I may remind my hon. friend that the Board of Trade appointed a special Committee to investigate this subject, and had already given effect to the recommendations of the Committee. All cases of fatal accidents attributed to gas poisoning are reported to the Dept., and reports thereon are made to them by the Medical Officers of Health. I should add that there has not been any marked change recently in the proportion of water gas supplied by gas undertakings.

SEWERAGE PURIFICATION.

Lieutenant-Colonel Assheton Pownall asked the Minister of Health whether his attention had been drawn to the discovery by Mr. Thomas H. Fairhrother, M.Sc., and Dr. Arnold Renshaw, of Manchester, of several dyes which in the activated sludge

process of sewerage purification could kill the devouring protozoa without harming the purifying bacteria; and whether he would give facilities for carrying out on a large scale the results of this highly important piece of laboratory research work.

Sir A. Mond replied that his attention had beeu drawn to the experiments referred to. He was, however, advised that further research work would be needed in order to test the application of this and other discoveries to the activated sludge process of sewage purification, and he was making inquiries as to the best means of facilitating the necessary investigations.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

THURSDAY, MAY 11, 1922, AT 4 P.M.:
ELECTION OF FELLOWS.

At 4.30 *p.m.* *Papers read*:—

Lord Rayleigh, F.R.S. (1) A Photographic Spectrum of the Aurora of May 13-15, 1921, and Laboratory Studies in connection with it; (2) A Study of the Presence or Absence of Nitrogen Bands in the Auroral Spectrum.

C. Chree, Sc.D., F.R.S. The 27-day Period (Interval) in Terrestrial Magnetism.

M. Barker. On the Use of Very Small Pitot-tubes for measuring Wind Velocity. *Communicated by Cr. G. I. Taylor, F.R.S.*

E. T. Paris. On Doubly Resonated Hot-wire Microphones. Communicated by Prof. H. L. Callendar, F.R.S.

Prof. J. C. cLennan, F.R.S., and D. S. Ainslie. On the Structure of the ' Line λ = 6708 A.U. of the Isotopes of Lithium.

ORDINARY MEETING—MAY 4, 1922.

Sir Charles Sherrington, President, in the Chair.

The following papers were read, the Summaries here printed having been supplied hy the Authors for use at the Meeting:—

C. Shearer, F.R.S. On the Heat Production and Oxidation Processes of the Echinoderm Egg during Fertilisation and *early Development.*

In this paper an attempt is made to measure the heat liberation of the egg of *Echinus miliaris* during fertilisation and early development, and to correlate this with the amount of oxygen consumed and the carbon dioxide given off at the same time. New methods hitherto unused for *this purpose have been employed.* The heat production has been measured by meaus of the differential micro-calorimeter, while the oxygen consumption and carbon dioxide output have been estimated with the differential manometer.

In one hour, 1 million unfertilised eggs (8 mgrm. egg N.) consumed 15.1 c.mm. of oxygen at standard barometric pressure (760 mm. Hg.) and Temp. 14.5° C., and gave off at the same time 0.067 grm. calorie *of heat. In a similar interval the* same uantity of fertilised eggs under the same conditions consumed 86.4 c.mm. oxygen (with a corresponding output of CO_2.; respiratory quotient, 0.92), and liberated 0.397 grm. calorie of heat. Thus the fertilised egg gave off 6 to 7 times more heat, and consumed 6 to 7 times more oxygen than the unfertilised egg.

The heat production of the egg-cell in one hour, expressed in grm. calories, divided by the oxygen consumption of the egg in the same time, expressed in milligrams oxygen, gives a calorific quotient Q. This was found to be approximately the same value in the unfertilised as in the fertilised developing egg-cell, being 3.07 in one instance, as compared with 3.22 in the other. This would seem to show that extremely little of the very large amount of chemical energy liberated in the egg as the result of fertilisation, is expended in bringing about *the visible morphological structure of the* developing ovum. The heat liberation of the ovum after fertilisation rises progressively during development, reaching th highest point when the free-swimming stage is reached. The oxygen consumption and CO_2 output of tqhe egg follows the heat *liberation in all respects.*

Johan Hjort, For. Mem. R.S. Observations on the Distribution of Fat-Soluble Vitamines in Marine Animals and Plants.

The author, when studying the periodical changes in the size and quality of fish at different seasons of the year, found that these were associated with changes occurring i nthe content of fat. In Cod, for instance, the changes in the quality of the fish are most easily demonstrated by inspection of the size of the liver, an organ of which 50 per cent. consists of "cod-liver-oil." It was found that the liver of full-grown cod during the summer season, when the fish was feeding, weighed no less than three times as much as in winter, during the spawning season. The seasonal varia-

tions in the quality of the fish do not coincide with temperature variations, nor, in the case of the cod, with the availability of the animals which serve it as food.

The suggestion, therefore, arose that they might depend upon variation in chemical qualities of available food. It was therefore decided, as a preliminary to a full investigation, to study the distribution of fat-soluble vitamine in sea organisms, since these are known to exert a great influence on growth. The following materials were studied: (1) Green Algæ (Ulva); (2) Diatom-plankton; (3) Shrimps and prawns; (4) Hard roes of herring and cod.

It was found that the above materials, fed fresh or dried, had a very marked effect in re-starting and maintaining the growth of rats, when this had failed as a result of feeding upon a diet free from fat-soluble vitamine. Fats extracted from algæ and from roes had similar effect.

The results strongly suggest that fat of diatoms also contains vitamine.

H. Hartridge and R. A. Peters. Interfacial Tension and Hydrogen Ion Concentration. Communicated by W. B. Hardy, Sec. R.S.

Measurements of the interfacial tensions between oils, glycerides or fatty acids and various aqueous fluids were obtained by the capillary height, drop-weight, and ripple methods. The agreement between the results obtained by the three methods showed that any one of them could be used for studying the interfacial tensions in the case of these substances. The drop-weight method, owing to its convenience, was therefore employed alone for this research.

It was found that a decrease in interfacial tension between a fatty acid or glyceride and aqueous fluids occurs with increasing alkalinity of the aqueous fluid. This decrease is found to be dependent upon (a) the concentration of the fatty substance in the oil phase; (b) the presence of a certain concentration of alkali in the aqueous phase; (c) the hydrogen ion concentration at the interface.

Out of a series of pure chemical substances, it was found that only the substances having a COOH group (free or combined, as tri-glyceride) gave the interfacial tension changes described.

W. Cramer, A. H. Drew, and J. C. Mottram. Blood-Platelets: Their Behaviour in "Vitamin A" Deficiency, and after "Radiation," and their Relation to Bacterial Infections. Communicated by Prof. W. Bulloch, F.R.S.

The absence of the fat-soluble vitamin from the diet always leads in the rat to a progressive diminution in the number of blood-platelets. This thrombopenia is the only constant lesion which we have found, so far, in every case of vitamin A deficiency; and we regard it as the lesion characteristic of this deficiency, just as lymphopenia is characteristic of the vitamin B deficiency. Thrombopenia may even be found in rats kept on a vitamin A-free diet, when they do not yet show any obvious signs of ill-health and are to all external appearances normal animals. When profound thrombopenia has been established, addition of the missing vitamin A to the diet is followed by rapid increase in the number of platelets up to the normal, provided that the animal has not been allowed to suffer too long and too severely from deficiency.

Exposure to radium produces not only lymphopenia, but also, with sufficiently large doses, thrombopenia. From this the animals recover rapidly, if the application of radium is discontinued and the dose has not been too large.

If, by exposure to radium, or by withholding the fat-soluble vitamin, the number of platelets has been reduced below a certain critical level—about 300,000 for the rat—the resistance of the animal to infection is greatly diminished and infective conditions develop spontaneously. These may lead to a secondary anæmia. The infective conditions may clear up again as the number of platelets is made to increase.

Blood platelets fulfil an important function in the mechanism of resistance to bacterial infection. Alterations in local or general resistance to infection are associated with local or general changes in distribution of the platelets.

THE OPTICAL SOCIETY.

A lecture on "The Mechanical Construction of the Microscope from a Historical Standpoint," given by Prof. Alan Pollard before the Optical Society on April 27th, at the Imperial College of Science, dealt with the evolution of the instrument from the earliest times up to about the middle of the XIXth century.

Prof. Pollard divided his subject into two main periods, that of the non-achromatic, in which the early history of the single

lens or simple microscope was dealt with, and the achromatic. The mechanical details of outstanding historical compound instruments in these two periods which marked the progress of mechanical construction up to that of the modern compound microscope, were described.

Many famous instruments of the first period, such as John Marshall's "New Invented Double Microscope" of 1693, Culpeper's "Double Reflecting Microscope" of 1735, Cuff's "Double Constructed Microscope" of 1744, B. Martin's simple and compound of 1765, Bleuler's "Universal" of 1788, Jones' "Most Improved" of 1798 by Dollond, Gould's Pocket Microscope by James Smith in 1826 which marked the opening of the second period in this country, were set up with historical specimens so that their mechanical and optical performance could be compared.

In addition to the above, early catoptric instruments were shown, including Amici's reflecting microscope made for Dr. Wollaston in 1830.

The development in particular of the modern English limb from the Lister and Jackson designs and the so-called Continental limb from the early forms of Oberheuser and Nachet was traced and described.

The lecture was illustrated by lantern slides, and the historical instruments exhibited were loaned from the magnificent Court Collection as well as others in the South Kensington Museum by the courtesy of the Director, Col. H. G. Lyons, F.R.S.

ROYAL MICROSCOPICAL SOCIETY.

A Meeting of the Society will be held in the Lecture Hall at 20, Hanover Square, London, W.1, on Wednesday, 17th May, 1922, at 7.30 for 8 p.m., when the Annual Exhibition of Microscopic Pond Life will be held in the Lecture Hall and Library from 7.30 to 10 p.m. Offers of assistance from Fellows who can exhibit living specimens will be gladly received by the Hon. Secretaries.

The names of the following gentlemen will be submitted to the ballot for election as Ordinary Fellows of the Society:—

M. Arthur Benjamin Bradley, F.C.S.
Mr. James Joseph Jackson.
Mr. Arthur Mackay.
Mr. J. R. Norman.

The Metallurgical Section will meet in the Society's Library on Thursday, 25th May, 1922, at 7 for 7.30 p.m., when Mr. L. Singlehurst Ward, B.Sc., will make a communication, "Notes on Etching and Etching Re-Agents." Fellows of the Society are asked to extend an invitation to this meeting to any friends who may be interested.

Hon. Secretary: Mr. F. Ian G. Rawlins, White Waltham Grove, Maidenhead, Berkshire.

The Biological Section meets in the Library on the first Wednesday in each month, at 7 for 7.30 p.m. Hon. Secretary: Mr. J. Wilson, 3, West Park Road, Kew Gardens, S.W.

The Leather Industries Section.—Hon. Secretary: Dr. S. H. Browning, 22, Harley Street, W.1.

The Paper Industries Section is in course of formation, and will deal with researches relating to timber, wood pulp, paper, etc. Those who are interested in the subject and willing to assist are asked to communicate with Mr. James Strachan, F.Inst.P., 74, Blenheim Place, Queen's Cross, Aberdeen.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ANNUAL GENERAL MEETING, THURSDAY, 25 MAY, 1922, AT 6 P.M.

Notice is hereby given that the Annual General Meeting of the Institution of Electrical Engineers (Corporate Members and Associates only) will be held on Thursday, 25th May, 1922, at 6 p.m., at the Institution Building, Savoy Place, Victoria Embankment, W.C.2, to receive and consider the Accounts for the year ended 31st Dec., 1921, and the Annual Report of the Council, and to elect Auditors.

Copies of the Accounts and Report (which will in due course be published in the Journal) can be obtained from the undersigned.

By Order of the Council,
P. F. ROWELL, Secretary.

10th May, 1122.

ANNUAL CONVERSAZIONE, THURSDAY, 29 JUNE, 1922, 8.30 TO 11 P.M.

The Annual Conversazione will be held on Thursday, 29th June, 1922, 8.30 to 11 p.m., at the Natural History Museum, South Kensington, S.W.

Invitation cards will be issued in due course.

ROYAL INSTITUTION.

A General Meeting of the members of the Royal Institution was held on the 8th May, Sir James Reid, Bart., Vice-President, in the chair. The deaths of Sir Alfred Kempe and Sir William Phipson Beale, late Vice-Presidents and Managers, were announced, and resolutions of condolence with the families were passed. Mr. J. P. Blessig, Dr. W. D. Halliburton, Dr. E. H. Hankin, Mrs. Percy Macquoid, Mr. S. T. Nunn, and Mrs. Theodore Stephenson were elected members.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (CHEMICAL SECTION).

At the Annual General Meeting of the Chemical Section, held on Friday, 5th May, 1922, the following were elected officers and members of Committee for the Session 1922-23:—Chairman, Léonard E. Vlies, F.C.S., F.I.C.; Vice-Chairman, H. F. Coward, D.Sc., F.I.C.; Hon. Secretary, David M. Paul, B.Sc., A.I.C.; Committee, W. H. Bentley, D.Sc., R. H. Clayton, B.Sc., Harold Moore, M.Sc.Tech., F.C.S., A.I.C., Rona Robinson, M.Sc., A.I.C., David Bain, D.Sc., David Cardwell, M.Sc., F.I.C., J. A. Russell Henderson, D.Sc., F.C.S., FC.. Thompson, B.Sc., D.Met., and J. C. Withers, Ph.D., A.I.C.

CHEMICAL NOTICES FROM FOREIGN SOURCES

ACTION OF ACIDS UPOG AMMONIUM MOLYBDOMALATE—*E. Darmois.*—There are two distinct compounds of M_oO_3 with matic acid, viz., 2 M_oO_3 C_4H O_5 (dextro rotatory) and M_oO_3 $3C_4H$ O_5 (lævo rotatory). They give well defined salts of ammonium, and the salt of the former is very active. It is very sensitive to the action of bases, which convert it finally into a mixture of neutral molybdate and neutral malate. It is also very sensitive to the action of acids, hydrochlori cacid for example, causing a very rapid decrease of the rotatory power. Whatever the concentration, the rotation approaches a definite limit which is the same for HCl, H_2SO_4 and HWO_3, and which undoubtedly corresponds to the formation of a compound which resists the further action of the acid. The formula of the compound appears to be M_oO_3 $2C_4H$ O_5. Its rotatory power and its rotatory dispersion (much higher than that of malic acid or neutral ammonium malate) are characteristic. Acetic acid acts similarly to the mineral acids, but its action is not nearly so marked.—(*Comptes Rendus*, CLXXIV., No. 16, 1922.)

A NEW RADIOACTIVE MINERAL, SODDITE—*Alfred Schoep.* — Curite obtained from Kasolo (Katanga, Belgian Congo) is often associated with a mineral of yellowish colour. The minerals form crystalline aggregates of fine grain and tinged with orange colour. These aggregates are filled with veins, in which are brownish or reddish crystals of curite and yellow translucid or opaque crystals consisting of a new mineral. Its hardness lies between 3 and 4. Its crystals are rhombic, and they appear yellowish under the microscope. When they are heated in a closed tube they lose water and give off oxygen, at the same time turnink black. They do not regain their original colour on cooling. The powdered mineral is pale yellow. It is infusible before the blowpipe. It is soluble in acids, giving a gelatinous precipitate. The solution is coloured yellow by manium. The average composition of the mineral after it has been dried at 100° to constant weight is

SiO_2	7.85
NO_3	85.53
Fe_2O_3	.40

The composition can be expressed by the formula 12 U O_3 $5SiO_2$ $x4H_2O$. The author suggests the name soddite for this new mineral, the radioactivity of which corresponds to tre amount of uranium it contains.—(*Comptes Rendus*, CLXXIV., No. 16, 1922.)

ACID METHYLARSINATE OF STRYCHNINE—*J. Bouillot.*—Commercial methylarsinate of strychnine does not consist of the neutral salt, for its percentage of arsenic is much too high, and that of strychnine too low. When the pure methylarsinate is prepared from methylarsinic acid and strychnine, it forms long colourless needles which are less bitter than the sulphate. It is lævorotatory. It can be kept at the ordinary temperature, but decomposes when heated above 60°. On platinum foil it burns with an odour of cacodyl. The analysis of the compound shows that strychnine combines molecule for molecule with methylarsinic acid giving a well defined acid salt which crystallises with two molecules of water, and the commercial methylarsinate used in therapeutics corresponds to this acid salt. The acid salt contains only 65.49 per cent. of strychnine, while the dibasic salt contains 77.49 per cent.—(*Journ. Pharm. Chim.*, II., 289, 1921, and I., 92, 1922.)

POLYMERISATION OF LÆVOGLUCOSANE—*Amé Pictet and J. H. Ross.*—When lævoglucosane is heated to 140° in presence of a trace of zinc chloride, the reaction $nC\ H\ O_5 = (C\ H\ O_5)_n$ takes place in a few minutes, but different products are obtained, according to the pressure. If the pressure is gradually raised, the value of n increases from 2 to 4, 6 and 8. Thus a series of polylævoglucosanes can be obtained comparable with the polyamyloses which bring about the progressive degradation of starch under the influence of Bacillus macerans. At a pressure of 15 mm. dilævoglucosane is obtained; this differs from lævoglucosane in that it is insoluble in acetone, from which it can be precipitated in the form of a white amorphous powder, fusing at 135° without decomposing. It is very soluble in water, acetic acid and pyridine, but insoluble in other solvents. At atmospheric pressure the product obtained by heating lævoglucosane is tetralævoglucosane, while at a pressure of 4.6 atmospheres the hexa polymer is formed. This differs from the other two polymers in being insoluble in pyridine. At 13.3 atmospheres the octopolymer is formed. Thus the polymerisation of lævoglucosane at a constant temperature but at increasing pressures gives products the properties of which are more and more like those of the dextrines. This fact seems to be of interest in connection with the transformation of sugar into starch in plants, the transformation taking place at high pressures, possibly higher than those employed in this series of experiments.

NOTES ON BOOKS.

Creative Chemistry, descriptive of recent achievements in mechanical industries, by EDWIN E. SLOSSON, M.S., PH.D. 311 pp. *Illustrated.* Hodder & Stroughton. University of London Press, 18, Warwick Square, E.C.4. Price 12s. 6d. net.

The author, in his book, aims at relating the modern development of chemical science in its widest aspect and in a popular manner, so that the importance of science to human existence may be readily grasped by the uninitiated. It has been shown again and again that the recent war has added a tremendous impetus to the development of chemical science in every industry.

The book is profusely illustrated, and a very great deal of prominence is given to the part played by chemistry in the war. The author's style is original and will most certainly appeal to the younger generation, particularly in America, for in many instances the progress of discovery is viewed from a decidedly American standpoint. The author divides the progress of chemistry into three periods—the appropriation period, the adaptive period, and the creative period—and at the end of this succession of eriods he seems to expect the substitution of an artificial world for what we now know is the natural world, where "Man the Artifex will ultimately master nature and reign supreme over his own creation . . . until chaos come again." Not a very hopeful outlook certainly. In this connection the quotation from M. Berthelot is given where it is said that "the day will come when each person will carry for his nourishment his little nitrogenous tablet, his pat of fatty matter, his packet of starch or sugar, his vial of aromatic spices suited to his personal taste—all economically manufactured and in unlimited quantities, all independent of irregular seasons, drought and rain." In spite of this somewhat fantastic statement the various chemical processes met with in our common daily life are described in great detail.

The chapter on synthetic plastics gives a good idea of the author's style. We are told that Alfred Nobel once cut his finger, and daubing it over with collodion was led to the discovery of the high explosive dynamite, and that later on John Wesley Hyatt, the son of a blacksmith, got a sore finger and resorted to the same remedy, but when he got to the cupboard where the material was kept the bottle had fallen over and the collodion had run out and solidified on the shelf. "Possibly Hyatt was annoyed, but if so, he did not waste his time raging round the office to find out who tipped over that bottle. Instead, he pulled off from the wood a bit of the dried film—he found it tough and elastic. It occurred to him that it might be worth 10,000 dollars. It turned out to be worth many times that."

From these accidental discoveries followed celluloid, and later on the valuable compound of phenol and formaldehyde discovered by Dr. Baekeland and now called Backelite, and many similar compounds that are rapidly becoming of the greatest value.

A very interesting chapter is devoted to the production of sugar from beetroot and the sugarcane. Chapter 12, which comes between one on fats and sugars and another on the products of the electric furnace, is devoted to poison gases and their use in the war. The chapter is, of iourse, interesting, but it seems rather out of place, and deals with a subject we would like to forget. The use of these gases made by Germany will remain to her everlasting disgrace, but it is a relief to turn from this chapter of chemistry to more reasonable developments of chemical science that are found at the end of the book—the discovery of the more recent steels and rare elements and their new compounds is described in an interesting manner, particularly with respect to tungsten and molybdenum alloys.

A good description is given of the discovery by Dr. Auer von Welsbach of the method of illumination known all over the world as the Welsbach mantle. The final chapter deals briefly with the discovery and properties of radium. At the end of the book the author has collected together a number of reading references, dealing with the literature included in each separate chapter, that will greatly help the development of the study of the subjects that have been treated in the book. This will be found very useful both for teachers and for ordinary readers who are interested in the modern developments of chemistry.

J. H. G.

Chemical Technology and Analysis of Oils, Fats and Waxes, by Dr. J. Lewkowitsch, M.A., F.I.C. Sixth Edition, entirely revised by George H. Warburton. Vol. II. McMillan & Co., St. Martin Street, London. Price 42s. net.

The work of Dr. Lewkowitsch on the above subject is too well known to need any remarks, and the chemical world will certainly welcome the appearance of the second of these most important volumes. The book occupies close upon 1,000 pages, is thoroughly well illustrated, and contains a deal of valuable tabular matter.

The first portion of the present volume is devoted to the commercial preparation of the raw materials in the oils, fats and wax industries, and the next chapter gives the technology of the natural materials, their method of preparation and refiniug, and the name of the product is given in English, French, German and Italian. A very large number of oils and waxes are indexed, occupying some six pages, and a full description is given of the source, properties, and chemistry of eacb species.

The book is very thoroughly illustrated and indexed, and will remain a standard book of reference on the subject for a long time to come. J. H. G.

PLATINUM.

By George F. Kunz.

(Continued from Last Week).

In spite of the marked distinctions noted above, the discovery of platinum in the Ronda district by Senor Orueta resulted from his comparison of the eruptive rocks here with those of the platiniferous deposits of the Urals, as they had been described in 1911 by Prof. Duparc. This caused him to arrive at the conclusion that the peridotites of the Ronda district were also platiniferous. He therefore examined the alluvials of the rivers which traverse these peridotic masses, and he was rewarded in 1915 by finding platinum in all those which he tested.

TECHNOLOGY AND BIBLIOGRAPHY.

The production of platinum, having a higher degree of purity than has heretofore been attained, has been realised lately by the Bureau of Standards. It is claimed that Heræus platinum,[1] long regarded as the standard for apparatus which requires the highest degree of purity, has been surpassed. This has been made possible by exercising a rigid control in the operation o fsmelting so that any calcium admixture can be almost entirely removed, as this admixture affects some of the physical properties of platinum.

Extremely fine platinum wire, of a type that in pre-war times was mainly produced by the Germans, is now manufactured here by an American company.[2] A platinum core is embedded in a silver wire, and after the wire has been drawn out until it becomes very fine, the silver is removed by acid. The platinum wire that remains is of extraordinary fineness, being only 0.00006 in. in diameter. With a trifle less than 50 troy oz. of platinum (1,555 gm.) it would therefore be possible to make a wire that would girdle the earth at the equator.

A new use of platinum has been noted by Donald W. Howe in an address before the Rochester section of the American Chemical Society. This concerns the employment of the metal as a hardener of vegetable oils. For this purpose "platinum black" is used, the material obtained by chemical combination of platinum with muriatic and nitric acid, and burning of the resulting platinum chloride on asbestos. The action of platinum black on the oils is similar to that produced by nickel.

The most authoritative and complete work on platinum and platinum deposits has very recently been published in Geneva by Louis Duparc, professor of mineralogy and petrology in the University of that city. Associated with him in the authorship was Marguerite N. Tikonovitch.[3]

[1] *Op. cit.*, p. 254. Also Don Domingo de Orueta, "Resultado practico del estudio petrographico de la Serrania de Ronda," *Revista Miniera*, Nov. 8, 1915.

[2] *Chem. Met. Eng.*, Apr. 20, 1921.

[3] Louis Duparc and Marguerite N. Tikonovitch, "Le Platine et les Gites Platinifères," Geneva, 1920, 600 pp., text ill., 90 stereotype pls., 11 in black and colour, 8 of dredges, etc., atlas of Ural deposits, etc. Published by the Société Anonyme des Editions "Sonor," 46, Rue ... des Saisons N.S..

No one could be better ualified to execute this task than Professor Duparc, who has long been known as the writer of many papers on the great platinum deposits of the Urals region in Russia, of which he has made a special study. He has also investigated personally the notable platinum deposits in other parts of the world, and the present work embodies the results of over twenty years of careful investigation as to the sources and exploitation of this rare and useful metal.

The work opens with a very comprehensive study of the topography and geology of the Ural region; this leads up to a chapter on the various "mother rocks" of platinum, and to a full description of the primary platiniferous centres, namely the dunites and peridotites, and to notes on the pyroxenites and koswites, as well as on the rocks of the gabbro family and other vein rocks, and on the metamorphosic rocks which appear in the eruptive platiniferous zone. Then the constituent elements of native platinum are presented, the condition in which it is found in the deposits, and the probable origin of the latter. To this succeeds a chemical section, giving a number of analyses of platinum ores and detailing the methods used in these investigations. The secondary deposits and the platiniferous alluvials are then passed in review. Following the exceedingly full description of the Uralian deposits, Professor Duparc more briefly treats of the platinum deposits in other parts of the world, in San Domingo, Honduras, equatorial Colombia, Brazil and French Guiana, in the United States, and in Mexico and British Columbia. Details are also given regarding the deposits of Oceania, Borneo, New South Wales, New Zealand, and Tasmania. The African deposits of the Transvaal are noted, as are the claims that Madagascar is a platinum producer.

The metallurgy of platinum and the methods used for the extraction and separation of the various metals of the platinum group are given at considerable length. To this very naturally succeeds a presentation of the different uses to which these metals have been put, and the work concludes with a chapter of statistics of platinum production. The first 100 copies of this great work were not in trade, and for each of the 500 copies numbered 101 to 600, subscribers were charged 100 francs, the price through ... being 125 francs. It must b

borne in mind that these are Swiss francs, with only about 10 per cent. discount.

Another important publication in the platinum field is a new edition of the valuable bibliography of platinum literature by Prof. James Lewis Howe. The first edition appeared in 1897, and was exclusively the work of Prof. Howe; in this second edition he acknowledges his indebtedness to a continuation by Dr. Hendrick Coenraad Holtz, then of Amsterdam, who carried the work down to 1910. This supplementary matter was completed by Prof. Howe, and all the literature was included up to 1916. A comparison of the number of titles given in these two successive editions of the bibliography will show how much more complete the second is than the first. In the edition of 1897 there were in all 2,440 titles, but in that of 1917 the number is increased to 4,561, not far from double. The titles are given in chronological order, those of each year being separately numbered. There is a complete, alphabetical author-index, which covers 29 pages, the literature for each subject being listed in chronological order, with the year and the author's name, as well as the year number under which it appears in the bibliography.[1]

Due notice is taken in the bibliography of the annual platinum reports in "Mineral Resources" issued by the United States Geological Survey, where they have been treated successively since 1904 by David T. Day, F. W. Horton, Joseph Struthers, Waldemar Lindgren, and for the past 10 years by Dr. J. W. Hill. Companion pieces to these reports are the ones issued annually in our own publication since 1892, these having been furnished in the successive years by Charles Bullman, Henry Louis, Joseph Struthers, L. Tovey, Frederick W. Horton, F. Lynwood Garrison, and in the years 1916 to 1919 by the present writer, who also furnished the platinum data for the Eleventh Census (of 1890), with photographs he took while studying the Uralian deposits, and who contributed to the *Bulletin of the Pan-American Union* for November, 1917, a paper entitled "Platinum: with especial reference to Latin America," as well as a paper on palladium deposits of Brazil in a later issue of the Bulletin.

Among the monographs issued by the "Imperial Institute" on the mineral resources of the British Empire, is one by A. D. Lumb on "The Platinum Metals." It contains a small-scale map of the world, on which are marked the positions of the various platiniferous districts treated of in the text of the book.

[*Abridged report on the production of Platinum for the year* 1920 *from "Mineral Industry," Vol. XXIX.*]

[1] "Bibliography of the Metals of the Platinum Group, Platinum, Palladium, Iridium, Rhodium, Osmium, Ruthenium, 1748—1917," by Jas. Lewis Howe and H. C. Holtz, Washington, D.C., 1919, 558 pp.; U.S. Geol. Surv. Bull, 694. The first bearing only Prof. Howe's name, was published by the Smithsonian Institution, Washington, D.C. 1897, 318 pp.

NOTES ON THE MANIPULATION OF OSMIRIDIUM CONCENTRATE.

By R. A. Cooper.

As a number of assayers and others now handle osmiridium in the ordinary course of their duties, it has been thought advisable to publish a note warning anyone concerned of the danger of coming in contact with vapours of the volatile compounds of osmium and ruthenium.

Roscoe states that "Osmium undergoes oxidation somewhat readily when finely divided, being oxidised and volatised when heated in air below 212° and in oxygen below 170°, but not below 155°.

"When strongly heated in air, oxidation of the compact metal also takes place, and this operation is attended with great danger owing to the formation of the highly poisonous tetroxide. Deville in this manner was rendered almost blind for 24 hours by having accidentally become exposed to the vapour of tetroxide. This substance produces the most violent pain and inflammation of the conjunctiva, and vision is permanently injured by the subsequent reduction of a film of metallic osmium.

"The tetroxide has a most powerful penetrating smell, somewhat analagous to that of chlorine and iodine. A very small quantity of vapour mixed with air attacks the lungs, giving rise to very serious inflammation of the mucous membrane. As an antidote to these effects Claus recommends the inhalation of sulphuretted hydrogen, which, however, must be cautiously employed.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom *all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.*

Latest Patent Applications.

10902—Bengue, J.—Stopper for glass containers for *ethyl chloride, etc.* April 18.

11257—British Cellulose & Chemical Manufacturing Co., Ltd.—Manufacture of plastic materials. April 21.

11236—Christopher, J. R.—Apparatus for neutralising and drying sulphate of ammonia. April 21.

11325—Cocksedge, H. E.—Process and manufacture of a sodium compound and a composition containing same. April 22.

11405—Dunstan, A. E.—Treatment of liquid hydrocarbons. April 22.

11037—Farbenfabrik vorm. F. Bayer & Co.—Manufacture of azo-dyes. April 19.

Specifications Published this Week.

177,820—Fraymouth, A. W. Method of and apparatus for the extraction of soluble matter *from powdered or crushed material or* substances other than tanstuffs.

177,839—Simpson, T. R.—Concentration of ores containing elemental sulphur.

156,170—Koppers Co.—Manufacture of ammonium sulphate.

156,190—Boehringer Sohn, C. H.—Process for the *production of alpha-lobeline*

156,245—Wohl, A.—Process for catalytic oxidation of hydrocarbons into carbonyl compounds or acids.

Abstract Published this Week.

Anthraquinone.—Patent No. 176,235.—A new method of preparing Anthraquinone has been Patented by Mr. F. W. Atack, of the British Alizarine Co., Ltd., Trafford Park, Manchester.

The product is obtained by condensing o-benzoylbenzoic acid with sulphuric acid of 75-80 per cent. strength. The process may be made continuous by continuous addition of molten o-benzoylbenzoic acid and by maintaining the strength of the sulphuric acid either by evaporation such as by blowing in air or by addition of oleum. The anthraquinone separates on cooling from the comparatively weak acid, and may be withdrawn periodically.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each.

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CHEMICAL SOCIETY RESEARCH FUND.

A MEETING of the Research Fund Committee will be held in June next. Applications for Grants, to be made on *Forms which can be obtained from the* Assistant Secretary, Chemical Society, Burlington House, W.1, must be received on or before Thursday, June 1st, 1922.

All persons who received grants in June, 1921, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be returned by Thursday

THE CHEMICAL NEWS,
VOL. CXXIV., No. 3241.

THE ROYAL SOCIETY CONVERSAZIONE.

MAY 17TH, 1922.

The "Black Soiree" of the Royal Society met with the usual success. There was a very good attendance of Fellows and their friends, and a large number of interesting exhibits. A short Lantern Lecture was given during the evening by the Lord Rayleigh, F.R.S., on the subject of the Aurora Borealis and its Spectrum.

Photographs were shown illustrating some recent spectroscopic investigations on the aurora, particularly its occurrence on ordinary nights in the South of England.

Amongst the more interesting exhibits were some remarkably fine specimens of native gold recently found in Devonshire. Casts of a large Gastropod found near Hastings, measuring seven feet in length; some interesting finds by the British School of Archæology in Egypt, and a Clock designed by the late Lord Kelvin, which is now permanently fixed in the Hall of the Society. The following is the official description of a selection of the exhibits:—

The British School of Archæology in Egypt.

1. Wooden statuette of an Egyptian youth, VIth dynasty.

This is one of three statuettes of different ages, found in a tomb with an alabaster head-rest, giving the name of Ra-mery-hashetef. The anatomical detail is rendered with remarkable care, representing a youth of about sixteen years.

2. The Earliest Hebrew Papyri; and a Greek letter of 18 B.C.

These portions of letters and liturgical songs are dated by Greek documents found with them of the early third century A.D. The forms of letters resemble the stone inscriptions of the first century. The Greek letter of Dionysia is an unusually perfect example.

Radiological Branch, Research Department, Woolwich.

Metal X-ray Tube, water cooled, with Iron Target.

The tube is of the hot cathode type, and is constructed chiefly of metal—the insulation between the anode and the case being secured by a glass sleeve. Both the anode and the metal case are water cooled. The tube is self shielding—only a narrow pencil of X-rays escaping from an aluminium window.

The tube is designed to give the characteristic radiation of iron, and to run continuously with a heavy current.

Department of Zoology, Natural History Museum. (Mr. C. Tate Regan, F.R.S.)

1. Giant Frogs—*Rana goliath* and *R. guppyi.*

R. goliath, from S. Cameroon, is the largest known frog, attaining a length of nearly 12 inches, without the limbs; the exhibit shows a specimen eating a rat (*Lemniscomys striatus*). *R. guppyi*, from the Solomon Islands, feeds almost exclusively on crabs (*Cardisoma* and *Sesarma*), which are swallowed whole.

Mr. George H. Gabb.

The original portrait of Galileo by Justus Sustermans, in oil, painted for the Pandolfini Palace at Florence, when Galileo was about 75 dears of age.

He is represented seated in a chair, holding a vellum telescope in his right hand.

This may ye regarded as the most faithful and noblest portrait of Galileo, and probably the last done of him. It is mentioned in Waagen's "Art Treasures of Great Britain," 1859, as being then in the Methuen Collection.

Department of Geology, British Museum (Natural History).

A Gigantic Freshwater Gastropod from Wealden Rocks.

Found during the construction of a new road near Silver Hill, Hastings, close to the quarry known as the "Iguanodon Necropolis," in beds of the Wadhurst Clay Series. These beds, originally a blue calcareous sandstone, have mostly been altered by percolating water to a rusty brown sand-rock.

The internal casts shown occurred in association with ordinary concretionary masses, for which they were easily mistaken when only portions were visible. They differ, however, in being regular logarithmic spirals (right and left-handed), and in other ways. The big right-handed spiral was complete when found, but suffered loss through blasting operations, and the removal of portions by unauthorised persons

Enough has, nevertheless, been recovered to enable a restoration to be made. Twenty-three whorls, including the body-whorl, are traceable, with a total length of 7 ft. 3 ins. The affinities of the mollusc are probably with the Tiaridae (*olim* Melaniidae), rather than the estuarine forms of Cerithiidae.

Mr. A. A. Campbell Swinton, F.R.S.

Radio-telegraphic Records.

These are specimens of the results obtained by several different methods of recording wireless signals, as follows:—

(1) Photographic records from a String Galvanometer directly connected in the aerial circuit.

(2) Photographic records from a Sensitive Manometric Flame caused to dance to telephonic sounds.

(3) Records by Siphon Pen and Morse Inker, actuated by Brown Relays and Crystal Detector.

(4) Records by Siphon Pen actuated by Thermionic Valves.

(5) Creed perforated Tape obtained with Thermionic Valves, and resulting print in Roman type.

The String Galvanometer records were obtained in 1910 in Copenhagen, with signals sent from Tralee, in Ireland. All the others were taken in London, some of them before the war, from sundry transmitting stations, many of which were in different parts of Europe, the most distant being Moscow.

Prof. W. T. Gordon.

Native Gold recently discovered near Torquay, Devon.

Gold has been recorded from several localities in Britain, but usually only in small quantities. The specimens so far obtained from this new locality are very rich, but the amount of material available is unknown, so that no idea of the value of the find can be given. The metal occurs in a crystalline condition, with dendritic habit, in the calcite cement of a fault-breccia near Hope's Nose, Torquay; and the specimens are quite striking when a fortunate fracture exposes the fern-like gold dendrites.

The Science Museum, South Kensington.

1. **Original Microphones and Experimental Apparatus of David E. Hughes, F.R.S.**

This original and historical apparatus was made and used by Professor Hughes in his experiments, which led him from the discovery of the microphone in 1878 to the transmission and reception of wireless signals in 1879. The original model of his induction balance is shown, as well as several examples of pencil and granular microphones; also his transmitting and receiving apparatus for wireless signals.

[Prof. Hughes exhibited his induction balance at the Royal Society's Conversazione on May 28, 1879.]

2. *A Microscope with Geometrical Slides.*

This model of a microscope upon geometrical principles was constructed by the late Dr. Keith Lucas, F.R.S., about 1896, and though roughly and cheaply constructed, the instrument is so designed as to permit such precise relative movements of the various co-acting parts of the instrument, that critical microscopic work can be carried out with it.

Mr. R. C. Gale and Capt. E. R. Macpherson.

Wrought Iron Currency from the Kisi Country, Sierra Leone Protectorate, West Africa.

This form of currency was in use prior to the establishment of the British Protectorate in 1787, and is of native workmanship. Analysis and photomicrographic examination show it to consist of wrought iron.

	%
Carbon	0.095
Silicon	0.103
Manganese	nil
Sulphur	0.024
Phosphorus	0.046

The photomicrograph (× 275) taken at B, shows the typical ferrite crystals and slag inclusions found in wrought iron. The metal is soft and easily bent, the Brinell hardness at A being 121.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING—MAY 11, 1922.

Sir Charles Sherrington, President, in the chair.

The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

LORD RAYLEIGH, F.R.S. (1) *A Photographic Spectrum of the Aurora of May 13-15, 1921, and Laboratory Studies in connection with it*; (2) *A Study of the Presence or Absence of Nitrogen Bands in the Auroral Spectrum.*

(1) A photographed spectrum of the Aurora obtained on the night of May 14, 1921, is reproduced. It shows the negative bands of Nitrogen in considerable detail, also the green aurora line of unknown origin, which, however, is subordinate. A number of laboratory photographs of the negative bands of Nitrogen excited in various ways are reproduced for comparison.

With atomic ray excitation, and still better in the narrow positive column (capillary tube) at low pressure the development of the negative bands can be imitated, but Nitrogen spectra (line spectrum and second positive band spectrum) persistently appear in addition.

The cathode ray spectrum is free from these foreign spectra, but the negative bands produced in this way are not developed like those in the aurora, the intensity being much more concentrated in the first band of each group. Hard and soft cathode rays behave alike in this respect.

The auroral spectrum is also discussed in relation to the upper atmosphere. Assuming that helium is the main constituent above 130 kilom., as the theory of diffusion indicates, then it is difficult, on the hypothesis of positive ray excitation, to explain its absence from the spectrum of this particular aurora, which at Christiania reached to 470 kilom. Experiments on artificial mixtures indicate that it should be visible. With cathode ray excitation, this difficulty would be lessened, but the different development of the Nitrogen bands remains.

(2) Spectra of the "Northern Lights" taken in Shetland with the assistance of Mr. J. Crichton of the Meteorological Observatory there, are compared with spectra of the ordinary night sky at Terling, near London.

Most of the Shetland spectra show Nitrogen bands. None of the ordinary Terling spectra show these bands, though, owing to the long exposure given, the Terling plates show the green aurora line of unknown origin as strongly, or more strongly, than the Shetland spectra.

On the occasion of the great magnetic storm and world-wide auroral display of May 13-14, the Nitrogen bands were strongly developed at Terling. But this stands out in strong contrast to what is observed on ordinary nights.

C. CHREE, Sc.D., F.R.S. *The 27-day Period (Interval) in Terrestrial Magnetism.*

There is a tendency in terrestrial magnetism for disturbance to follow disturbance, and calm to follow calm, after an interval which is not an absolute constant, but does not depart much from 27 days. This phenomenon is investigated as displayed by the absolute daily range of declination at Kew Observatory from 1858 to 1900, and as exhibited in the international "character" figures from 1906 to 1920.

The phenomenon is clearly recognisable in almost every year of the long period considered. Generally speaking, it is more clearly exhibited in years when sun spots are few in number or are situated in low solar latitudes. The season of the year seems to have little, if any, influence on the phenomenon.

M. BARKER. *On the Use of Very Small Pitot Tubes for Measuring Wind Velocity.* Communicated by Mr. G. I. Taylor, F.R.S.

Dr. Stanton, in a paper published recently ('Proc. Roy. Soc.,' 1920, A), explains a method of calibrating a one-sided Pitot Tube which he uses for measuring wind velocities close to the walls of a pipe. The results of his calibration give a finite pressure in the tube when the opening becomes infinitely small.

In the present paper this experimental result is justified on theoretical grounds, and it is shown that the finite pressure in the tube for infinitely small openings is comparable with that at the nose of a sphere, of diameter equal to the breadth of the opening, placed in a stream moving with a velocity equal to that at the centre of the pitot opening.

The above result indicates a breakdown in the $p = \frac{1}{2}\rho v$ law for Pitot Tubes, when the dimensions of the pitot are very small or the velocity very low, ρ being the density

and v the velocity of the fluid and p the pressure difference. The present paper describes an experiment made to determine the value of rv/ν below which the $\frac{1}{2}\rho v$ law ceases to hold, γ being the radius of the circular Pitot Tube and ν the kinematical viscosity of the fluid.

The results show that, for values of $\gamma v/\nu < 30$, $p/\rho v$ is greater than $\frac{1}{2}$, and a curve of the usual "scale effect" type is obtained. Below this value, which incidentally is greater than the smallest used by Dr. Stanton in his experiments, there is a viscosity effect which shows itself in the form of an additional pressure comparable, as before, with that at the nose of a certain sphere.

E. T. Paris. On Doubly Resonated Hot-wire Microphones. Communicated by Prof. H. L. Callendar, F.R.S.

The paper records the result of investigations into the properties of double resonators which can be used with hot-wire microphones in order to increase sensitivity and also, if desired, to widen the range of response. Two types of resonator are dealt with, namely:—

(1) The "Boys double resonator," consisting of a "stopped pipe" in series with a Helmholtz resonator. The theory is given and experiments are described which illustrate the results obtained.

(2) The "Helmholtz double resonator," consisting of two Helmholtz resonators in series. Rayleigh's theory is extended, and experiments are described, the results of which show a satisfactory agreement with the theoretical formulæ. The form of the resonance curves is discussed and the conditions affecting the sensitivity.

Prof. J. C. McLennan, F.R.S., and D. S. Ainslie. On the Structure of the Line $\lambda = 6708$ A of the Isotopes of Lithium.

In this investigation a study has been made of the structure of the lithium red line $\lambda = 6708$ A by using a vacuum arc in the vapour of the metal, and by using both Lummer plates and a 30-plate échelon gratin gcrossed with a Lummer plate to effect the resolution.

It has been shown that with strong arcs the wave-length $\lambda = 6708$ A consists of two doublets, with a separation of the doublet components of 0.128 A and 0.165 A respectively. The mean displacement of the two doublets was found to be 0.32 A, which is between 3 and 4 times the displacement demanded on Bohr's theory for isotopes of Li.

Attention is drawn in the paper to the results obtained by Merton and by Aronberg in studying the wave-length $\lambda = 4058$ A, in the spectrum of ordinary lead, and in that of lead having a radio-active origin. In these experiments it was found that the observed difference in wave-length was between 80 and 90 times as great as the difference to be expected in Bohr's theory.

With both lead and lithium it seems that, in what would appear to be isotopic spectral displacements, the value found by observation is about the atomic number times the value obtained by calculation on the basis of Bohr's theory.

Thursday, May 18, 1922, at 4.30 p.m.

Papers read:—

Prof. T. B. Wood, F.R.S., and J. W. Capstick, D.Sc. The Progress of Metabolism after Food in Swine.

J. A. Gardner and F. W. Fox. The Origin and Destiny of Cholesterol in the Animal Organism. Part 13.—On the Autolysis of Liver and Spleen. Communicated by Sir W. Fletcher, F.R.S.

C. G. Lamb. The Geometry of Insect Pairing. Communicated by Prof. J. S. Gardiner, F.R.S.

G. E. Briggs. Experimental Researches on Vegetable Assimilation and Respiration. XV.—The Development of Photosynthetic Activity during Germination of Different Types of Seeds. XVI.—The Characteristics of Subnormal Photosynthetic Activity resulting from Deficiency of Nutrient Salts. Communicated by Dr. F. F. Blackman, F.R.S.

Ernest Wilson. On the Susceptibility of feebly Magnetic Bodies as affected by Compression. Communicated by Prof. J. W. Nicholson, F.R.S.

S. F. Grace. Free Motion of a Sphere in a Rotating Liquid parallel to the Axis of Rotation. Communicated by Mr. G. I. Taylor, F.R.S.

List of Papers for Reading on May 25, 1922.

Prof. C. H. Lees, F.R.S. The Thermal Stresses in Solid and in Hollow Circular Cylinders concentrically heated.

B. F. J. Schonland. On the Scattering of β Particles. Communicated by Sir Ernest Rutherford, F.R.S.

N. K. Adam. The Properties and Molecular Structure of Thin Films. Part II.—Condensed Films. Part III.—Expanded Films. Communicated by Mr. W. B.

ROYAL INSTITUTION.

On Wednesday, May 24, at three o'clock, Dean Inge delivered the first of three lectures at the Royal Institution on "Theocracy"; the succeeding lectures will be given on Thursdays, June 1 and 8. On Saturday (May 27) Sir Hugh Allen begins a course of three lectures on "Early Keyboard Music," with musical illustrations by Harold Samuel. The Friday evening discourse on May 26 will be delivered by Professor W. E. Dalby, on "The Internal Combustion Engine: Its Influence and Its Problems," and on June 2 by the Hon. Maurice Baring, on "Gilbert and Sullivan," with musical illustrations.

PHYSICAL SOCIETY OF LONDON.

PROCEEDINGS AT THE MEETING HELD ON APRIL 28, 1922, AT THE IMPERIAL COLLEGE OF SCIENCE.

Dr. Alexander Russell, M.A., D.Sc., in the Chair.

"The Position of Best Focus in the Presence of Spherical Aberration," by T. Smith, B.A., F.Inst.P., National Physical Laboratory, was read by Mr. J. Guild in the absence of the author.

ABSTRACT.

Focal variations of phase in the presence of *spherical aberration are calculated* directly from the axial intersection points of rays of known inclination, and the graphical method employed shows that the focus for which phase variations have a minimum value may be found and suitably interpreted when the finiteness of the wave-length is disregarded. The diagrams here employed for the representation of spherical aberration have advantages over the more usual diagrams in several important particulars, and it is suggested that the older forms should be abandoned.

"The Determination of the Absolute Stress-variation of Refractive Index," by F. Twyman, F.Inst.P., and J. Perry, was read by Mr. Twyman, who also exhibited the apparatus to which the paper refers.

ABSTRACT.

The paper describes a ready method of determining the stress-optical coefficients, the Hilger interferometer being employed. Young's modulus of elasticity and Poisson's ratio are determinable simultaneously.

"An Experimental Comparison of the Viscous Properties of (a) Carbon Dioxide and Nitrous Oxide, and (b) Nitrogen and Carbon Monoxide," by C. J. Smith, B.Sc., A.R.C.S., D.I.C., Imperial College of Science and Technology, was read by the author.

ABSTRACT.

The present paper is the result of an experimental investigation to determine the viscous properties of (a) carbon dioxide and nitrous oxide, and (b) nitrogen and carbon monoxide. Direct comparisons have been made in each case by observing the time required by a mercury pellet to force an equal volume of gas through a capillary tube, at atmospheric and steam temperatures. For the above groups of gases the times of fall for each gas are equal at 15.0 C., and 100.0° C., and hence, independently of any knowledge of the absolute viscosity, it has been proved that the viscous properties are identical over the above temperature range. The absolute viscosity has been obtained by comparison with air, and the mean area of collision deduced by using Chapman's formula.

An Optical Sonometer was exhibited in action by Mr. F. Twyman, A.I.E.E., F.Inst.P. (A. Hilger, Ltd.).

The object of this instrument is to furnish graphs of the pressure variation in sound waves. The sound is directed by a trumpet upon a celluloid membrane a fraction o fa wave-length of light in thickness, which is silvered at a point between its centre and periphery. Rays from a pointolite lamp are concentrated on the silvered surface, and are reflected thereby through an ordinary and a cylindrical lens on to a photographic strip carried by a spring-driven chronographic drum. The duration and incidence of the photographic exposure are controlled by adjustable devices revolving with the drum. The constants of the membrane can be determined by measuring its curvature with an interferometer when it is being stressed by gravity, pneumatic pressure or electrostatic attraction. Good sound records can be obtained so long as the pitch of the sounds investigated differs considerably from the resonance pitch of the membrane, which is of the order of 200 per second.

SOCIETY OF GLASS TECHNOLOGY.

A Meeting of the Society, held in the Chemistry Lecture Theatre, University College, Gower Street, London, W.C.1, on Wednesday, May 17th, 1922, at 3 p.m.

AGENDA:

1. Minutes.
2. Applications for membership.
3. To receive and discuss the following papers: —

(a) "Columnar Structure in Sandstone Blocks," by John Currie, M.A.

(b) "Some Practical Notes on the Manufacture of White Glass in a Tank Furnace," by F. W. Adams, M.Sc.

(c) "The Composition of Lime suitable for Various Purposes in Glass Making," by Miss V. Dimbleby, B.Sc., and W. E. S. Turner, D.Sc.

WORKS EXCURSION.

By the courtesy of the directors, a visit was arranged to the works of Messrs. J. Powell & Sons (Whitefriars), Ltd., Whitefriars Glass Works, Tudor Street, London. E.C.4.

THE ROYAL STATISTICAL SOCIETY.

At a Meeting of the Royal Statistical Society, which took place in the hall of the Royal Society of Arts, on May 16, the President, Sir Henry Rew, K.C.B., took the chair, and Dr. Major Greenwood opened a discussion on the Scientific Value of Life Tables.

Dr. Greenwood submitted that the value of a life table as an instrument of research had been somewhat over-estimated, and that the opinion that important deductions could be drawn from local life tables which were not deducible from the death rates at ages was mistaken. A life table was an artificial product; its population was a fiction. It was not correct, for instance, to say that the average length of life of an English male was given by the "expectation of life" of any national table.

An "expectation of life" was deduced from the rates of mortality of contemporaneously observed lives and the comparison of such constants for different life tables was open to numerous criticisms. In the speaker's opinion, a Medical Officer of Health would learn little more from a life

NOTES ON THE MANIPULATION OF OSMIRIDIUM CONCENTRATE.

BY R. A. COOPER.

As a number of assayers and others now handle osmiridium in the ordinary course of their duties, it has been thought advisable to publish a note warning anyone concerned of the danger of coming in contact with vapours of the volatile compounds of osmium and ruthenium.

Roscoe states that "Osmium undergoes oxidation somewhat readily when finely divided, being oxidised and volatised when heated in air below 212° and in oxygen below 170°, but not below 155°.

"When strongly heated in air, oxidation of the compact metal also takes place, and this operation is attended with great danger owing to the formation of the highly poisonous tetroxide. Deville in this manner was rendered almost blind for 24 hours by having accidentally become exposed to the vapour of tetroxide. This substance produces the most violent pain and inflammation of the conjunctiva, and vision is permanently injured by the subsequent reduction of a film of metallic osmium.

"The tetroxide has a most powerful penetrating smell, somewhat analagous to that of chlorine and iodine. A very small quantity of vapour mixed with air attacks the lungs, giving rise to very serious inflammation of the mucous membrane. As an antidote to these effects Claus recommends the inhalation of sulphuretted hydrogen, which, however, must be cautiously employed.

"Osmium tetroxide also acts violently on the skin, causing a painful eruption which can be removed by the use of sulphur baths."

Sir William Crookes says that ". . . the deleterious effects of this body (osmium tetroxide) upon the lungs have not been exaggerated, and too much care cannot be taken to avoid inhaling it."

Ruthenium tetroxide is not readily formed from the metal by heating in air, but may be formed by the action of chlorine on solutions of potassium or sodium ruthenate prepared by fusing the metal with sodium peroxide, etc.

It is stated to be formed also when chlorates are added to acid solutions or when concentrated aqua regia solutions are boiled.

The tetroxide distils readily from heated

The ruthenium tetroxide vapour has a yellow or reddish colour and an irritating odour resembling that of ozone or nitrous fumes. According to Gutbier and Ransohoff it does not attack the mucous membrane, but cannot long be endured, and may produce severe symptoms of poisoning.

There should not ordinarily be any need for an assayer to heat osmiridium concentrates in the air, but if any such need arises the operation must be carried out in a very well ventilated fume cupboard discharging all vapours to the outside air. The osmiridium concentrates obtained on the Witwatersrand are slightly but distinctly soluble in even somewhat dilute aqua regia, and the osmium contents of such a solution are readily expelled as osmium tetroxide by even moderate heating.

When concentrates, after panning and nitric acid treatment to remove the heavy arsenic, nickel, vanadium, chromium minerals, etc., are bein gtreated with aqua regia to remove most of the gold, the acid should be very dilnte and cold. It is never advisable to hold the face over the container, and it is necessary to conduct the operation in fume cupboards. Aqua regia attack should never be carried to extremes when cleaning up concentrates, as, apart from danger of dissolving osmium there is no clear-cut limit to the action of the acid. Gold is certainly dissolved the most readily by weak—say 10%—aqua regia, but as soon as a large proportion of the gold has dissolved, action takes place on the platinum and rhodium. Apparently the latter two metals exist in these concentrates in the form of an independent alloy as they dissolve together.

Concentration of the acid by evaporation at this stage results in the solution of appreciable amounts of iridium, osmium, and ruthenium. Unfortunately any of these rarer metals dissolved are liable to be lost as their recovery is not always possible to the assayer. The aqua regia solutions should always be evaporated to low bulk by steam, diluted somewhat. and treated with a considerable quantity of ammonium chloride to precipitate the platinum and iridium. After 24 hours the precipitate is filtered off and washed with a fairly strong solution of ammonium chloride and ignited to obtain the metals, while the filtrate is diluted and treated with sodium sulphite to recover the gold. It appears to be advisable generally to leave about 1% of gold with the "osmiridium" to avoid dissolving much platinum, etc.

While discussing osmiridium it may be of interest to note that any estimate of the osmiridium content of a sample, based on the weight of the material left undissolved when the gold beads obtained by ordinary methods of assay are dissolved in dilute aqua regia, is liable to be misleading.

When a fusion is poured from the crucible, metals of the platinum group are all liable to be left to some degree adhering to the crucible, as they are not all alloyed with the lead but only held mechanically by it.

Hammering the lead button is another source of loss, while the changes during cupellation do not appear to have been investigated quantitatively. It would be natural to assume that osmium and possibly some ruthenium is volatilised during cupellation, but it is doubtful whether this is the case.

I have taken 0.1 gm. portions of the granular osmium + iridium + ruthenium metal free from gold, platinum and rhodium, and cupelled with silver, parted with nitric acid—warmed with dilute aqua regia—filtered off insoluble metals, ignited and weighed them. One such series gave the weights 0.138, 0.141, 0.140, and 0.131 gm. after this treatment; an average gain in weight of 37.5% due to oxidation of the metals. Very prolonged treatment with hydrogen at a high temperature was required to reduce the material to approximately its original weight.

With such material as Witwatersrand black sands (heavy sulphides, etc.) it is advisable to take a large portion of the sample—say 500 grams—dissolve all sulphides, etc., by feedin ggradually into nitric acid, wash the residue well with water, and decompose silicates by hydrofluoric acid followed by hydrochloric acid.

There remains a small quantity of very heavy material, largely vanadium and chromium compounds, which is undecomposed by these reagents, and also a white powder, possibly diamond dust, which latter cannot be removed by fusion either with alkaline carbonates or with bisulphates. These minerals are best removed by very careful washing from beaker to beaker by a fine jet of water until all "osmiridium" is separated from base minerals.

CHEMICAL NOTICES FROM FOREIGN SOURCES

SENSITIVENESS OF SOME REACTIONS OF HYDROCYANIC ACID — *Thure Sundberg.*—Using Koltoff's method of detecting hydrocyanic acid by the Prussian blue reaction, the author has shown that 0.023 mg. of HCN can be detected in 10cc. of solution (*i.e.*, 1 : 434). With guaiacum-copper sulphate paper 0.005 mg. of HCN give a decided blue colouration almost immediately. 0.0025 mg. give a blue colouration after one minute, and 0.001 mg. give a faint colouration after two or three minutes. Faint blue colourations could also be obtained with specimens of flour which had been exposed to air containing HCN, although the specimens had been kept for a month and a half in paper bags after the action of the gas. Benzidine and copper paper gives a pale blue colour after seven seconds, if the amount of HCN present is 0.0039 to 0.0046 mg. per 100 cc. According to the author, guaiacum gives a better colouration and acts more quickly than benzidine, but the latter has the advantage of being a reagent which keeps better.—(*Zeitschr. f. Analyt. Chem.*, 1922, p. 110.)

ELECTRO AND MAGNETO OPTIC EFFECT OF LIQUIDS WHICH CONTAIN METALLIC POWDERS IN SOLUTION — *M. St. Procopin.* — When liquids contain fine metallic powders in suspension they show negative birefringence both in electric and magnetic fields. The phenomenon does not disappear with the field, but there is a time of relaxation lasting two or three minutes for all metals except in the case of liquids obtained from mercury, when the birefringence disappears practically instantaneously. This is probably because the mercury particles in suspension are very small. Different liquids behave differently in a magnetic field, and there are indications that the phenomenon is due to the presence of traces of iron.—(*Comptes Rendus*, CLXXIV., 1922, 1170.)

ACTION OF THIONYL CHLORIDE UPON ACID ALCOHOLS—*E. E. Blaise and Mlle. Montague.*—When glycolic acid is gently heated over the water bath with at least two molecules of thionyl chloride, and the product is fractionated in vacuo, two substances are formed—the chloride of glycolic chlorosulphate CL-SO-O-CH_2-COCl, and chloracetyl glycolic chloride CH_2-Cl-CO-O-CH_2-COCl. The former is very readily decomposed when heated to about 180°, the products being SO_2 or chloride of chloracetyl. When treated with glycerine in presence of absolute ether, it yields the sulphite of glycolic anilide. This substance fuses at 140-141°; it is decomposed by water, is slightly soluble in alcohol in the cold and very soluble when heated. It is stable when heated in perfectly dry air, but loses SO_2 when heated in the atmosphere. The same decomposition occurs very rapidly when it is heated on the water bath with a little water, on evaporation to dryness a residue of pure glycolic aniline is obtained. Chloracetyl glycolic chloride can also be obtained by treating glycolic acid with chloracetyl chloride and heating the product thus obtained with thionyl chloride.—(*Comptes Rendus*, CLXXIV., 1922, 1173.)

STABILITY OF PERSULPHATES—*K. Elbs and N. Neher.*—If the persulphates of potassium, sodium and ammoninm are compared, it is found that the last is the least stable both when heated dry and in aqueous solution. This may be explained by supposing that the NH_3 is oxidised to N_2. The aqueous solution of these salts is slowly decomposed in the cold, more rapidly at about 35°, and very rapidly on boiling. The decomposition is made slower by the addition of Na_2 SO_4, and accelerated by the addition of acid or a large excess of fixed alkali. NH_4 OH accelerates the decomposition owing to the oxidation of NH_3 to N_2. Direct sunlight very greatly accelerates the decomposition of these solutions.—(*Chem. Zeit*, XLV., 1921, 1113.)

MODIFICATION OF SILICON SOLUBLE IN HYDROFLUORIC ACID—*W. Manchot.*—Moissan has already described this modification of silicon, but has not stated the circumstances in which it can be obtained. After many experiments the author has found that it is formed when a solution of silicon in fused silver is rapidly cooled by pouring it into cold water. Fused aluminium can be substituted for silver. In both cases part of the silicon is soluble in HF, while an insoluble portion is also obtained. The latter reacts very easily with oxidising agents. It is a light brown amorphous powder which takes fire in presence of chlorine or fuming nitric acid.—(*Ber. deut. Chem. Gesell.*, LIV., 1921, 3107.)

GENERAL NOTES

FLOGGING FOR DRUG SELLERS.

Colonel Burn asked the Home Secretary if the Government would support legislation introduced to authorise flogging and imprisonment without the option of a fine in the case of individuals convicted of carrying on the illicit drug traffic in this country, and deportation, in addition, if the offender was an alien.

Mr. Shortt replied: The question of taking further powers and strengthening the law is under consideration. The power to deport already exists, and is used whenever possible.

ZINC CONCENTRATES.

Captain Wedgwood Benn asked the President of the Board of Trade what was the quantity of concentrates and spelter received by the Government under the agreement with the Zinc Producers' Proprietary Association, Limited, Australia; what quantity had been sold; the total sum received from sales; and the profit or loss resulting from these transactions?

Sir William Mitchell-Thomson replied: The quantity of Concentrates and Spelter delivered to date is 836,000 tons and 5,000 tons respectively, of which 139,000 tons of Concentrates and 3,000 tons of Spelter have been sold. The receipts from sales amount to £443,500. The Zinc Concentrates and Spelter Trading Accounts as at 31st March, 1922, are in course of preparation, and the profit or loss cannot at present be stated. It is anticipated that the accounts to date will show a considerahle loss.

STATE OF THE CHEMICAL INDUSTRY.

During a discussion on the Board of Trade vote, Mr. Baldwin gave favourable reports of a number of trades, including the coal trade, the iron and steel trades, the cotton, wool, hosiery and leather trades. The chemical trade, he said, was improving, both in heavy and fine chemicals, but as regarded engineering and machine tools the less said the better. The electrical trades were fairly busy, and the textile machinery trade had been very busy. He was hopeful for the future.

A number of members criticised the action of the Government in passing the Dyestuffs Act, and the Safeguarding of Industries Act, but Sir William Pearce pointed out if those Acts had not been passed it was quite certain that the organic chemical industry of this country would have disappeared, and there would have been no dyestuffs industry and no fine chemical industry here. It would be quite impossible, in the present condition of the German industrial situation, for these industries to exist in this country unless they received the protection of these two Acts. Bery few people in this country realised how very powerful was the blast of the German opposition that had to be met. The dyestuffs industry in Germany had been treated with the same precision as their military work was treated by the German General Staff, and to-day the whole of the German chemical industries were controlled by one Board. For the industry in this country to stand up against these forces unaided was quite impossible, and therefore the Balfour of Burleigh Committee was right in its recommendation that, for the time being some protection must be afforded to these two industries. The German view was that they could afford to wait, and that the dyestuffs industry and the fine chemical industry in this country would be destroyed and we should be placed again in the position in which we were before the war, when we were dependent on foreign supplies. Not only the big German syndicate controlling the chemical industries, but the German Government had come to the conclusion that the organic chemical industry, including dyestuffs and fine chemicals, was one of the greatest assets they possessed. The same view was taken in America, but in this country we did not even yet realise the importance of these industries. It would be an enormons reproach to this country if British brains could not make these industries a success.

A London correspondent of the *Manchester Guardian Commercial* writes in this week's issue:—"Australian importers are crying out for catalogues of English goods and other publications giving details of our manufactures. News has reached London that American manufacturers are pouring literature of this sort into the Australian cities, and are thereby getting a good deal

of business which the importers would prefer to send to this country if they knew where to get the goods. In respect to many items, American catalogues and trade journals are the only publications the Commonwealth importers get in the English language, and business men on this side will realise what this means to American trade. I am informed that most of the public libraries in Australia would gladly place on their tables price lists and catalogues sent to them from this country, and if illustrated catalogues are sent so much the better. In the last six months the Americans have sent 620 lb. of trade magazines and technical literature to the Sydney public library alone. I understand that the manager of the Bank of Adelaide, 11, Leadenhall St., London, E.C.3, will forward to the Sydney library at stated periods any trade catalogues sent to him for the purpose, but I suggest that manufacturers should also send their lists direct to the various libraries, the addresses of which can be got from most good directories. The lists will be welcomed."

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH,

16 & 18, Old Queen St., Westminster, London, S.W.1.

The report described below has been published by His Majesty's Stationery Office for the Department of Scientific and Industrial Research. Copies, price 2s. (by post, 2s. 2d.) may be obtained through any bookseller, or direct from H.M. Stationery Office at the following address: Imperial House, Kingsway, London, W.C.2.

Physical and Chemical Survey of the National Coal Resources.—No. 1.

Correlation of Data for the Yorkshire, Nottinghamshire and Derbyshire Coalfield.

The fuel Research Board of the Department of Scientific and Industrial Research has had under consideration for some time the question of the physical and chemical survey of the coal seams of Great Britain, but the unstable conditions which prevailed in the coal industry during and since the war have necessarily led to the postponement of the work of organisation. In the meantime, however, work has been in progress on the collection and correlation of the data already available. The amount of information that can be thus drawn upon varies greatly in relation to the several coalfields. In the case of the Yorkshire, Nottinghamshire and Derbyshire coalfield, the records already in existence which have been collated are likely to gain considerable value by the correlation of the data in connection with corresponding seams in different localities. This report is accordingly published to bring together particulars and characteristics of the coal seams of the area.

Mr. E. W. Petter, Chairman of the Executive of the British Engineers' Association, Managing Director of Vickers-Petters, Ltd., and a member of the Executive Committee of the Industrial League and Council, has just returned from an extensive business tour in India. Interviewed by a Press representative, Mr. Petter gave some impressions of his visit.

"A tour such as I have just completed," said Mr. Petter, "is an education in itself. It makes one proud to belong to the British Empire. In that Empire we have untold wealth, and we, of this generation, have an unparalleled opportunity of developing it. We live in troublous times. As we make use of our chances we shall be judged.

"Industrially, India is developing very rapidly. Particularly is this the case in the textile, engineering, and porcelain industries. Many of the factories I visited in various parts of the country are wonderfully organised. It is doubtful, indeed, if the porcelain idols which are now made in India could be better made in Germany, from which country they were almost all imported before the war.

"Indian competition is very serious from our point of view. For the India operative has no restrictions on output, and no Trade Union regulations. He soon becomes skilled in the use of machinery, and he then goes ahead, working it to the limit of its capacity. India is now manufacturing everything she can within her own borders.

"In speaking of India, one has to remember that 90 per cent. of the population is agricultural. But with a population which numbers three hundred millions, the remaining 10 per cent. is by no means negligible.

"The Indian has certain grievances which will have to be remedied if the two countries are to work together in harmony. There are the social grievances, of which the chief is the alleged attitude of the official class towards the educated Indian.

There are the economic grievances, one of which is the belief that the British rigged the rupee exchange so that it fell from 2s. 9d. in 1920 to 1s. 3d. last year. And there are the many political grievances, all of which can be overcome by the exercise of a mixture of tact and firmness.

"On the other hand, where Indian administrators are in power, there is a tendency to allow corrupt methods to enter in which will have to be overcome. The Indian has not yet learned that the chief qualification the British official brings to his job is the most scrupulous honesty. On that depends his success."

NOTES ON BOOKS.

Plantation Rubber and the Testing of Rubber, by G. STAFFORD WHITBY, PH.D., M.Sc., A.R.C.Sc. Pp. XVI. + 560 + 8 plates. London: Longmans, Green and Co., 1920. Price 28s.

The extended use of automobiles has produced an increasing demand for rubber during the last few years. The supply of wild rubber was quite unable to meet this demand, and a vast extension of the plantation rubber industry has taken place, especially in the Eastern tropics.

The present volume, which is one of the Monographs on Industrial Chemistry, edited by Sir E. Thorpe, is a valuable contribution to the literature of the rubber industry.

The information it contains is very complete, and has been ably correlated by the author, whose task has been a difficult one, when it is recalled that important discoveries in this branch of applied science have been published in a very large number of journals, some of which are difficult of access for the general reader.

The author's difficulties are apparent by the frequent explanatory footnotes, and it is to be hoped that most of these will be incorporated in the general text in future editions.

In Part I. Dr. Whitby describes fully the preparation of rubber. It is pointed out that acetic acid is the best substance for coagulating the latex. The chemical nature of the resins, proteins and other substances which occur in rubber latex is also explained.

Part II. is devoted to the testing of rubber and the changes it undergoes on vulcanisation. The technique of these tests is adequately and admirably described, but the author deals almost exclusively with sulphur in the vulcanising processes.

In the case of rubber products, little value is attached to the results of chemical analysis alone. The mechanical properties of the product are naturally of more importance in this connection.

The comprehensive bibliography adds to the value of this Monograph, which is indispensable to all who are in any way connected with rubber technology.

J. G. F. D.

Home Chemical Laboratory, by R. F. YATES. Pp. 127. London: Henry Frowde, and Hodder & Stoughton, 1920. Price 4s. 6d.

The author states that this book "has been prepared for those who wish to become acquainted with the great fundamentals of Chemistry," but from its contents and style it is obviously intended for enthusiastic students who desire to supplement their chemistry courses with experiments at home.

Part I. deals with the structure of Matter from the standpoint of the Electronic Theory, and the author then proceeds to describe various chemical processes. Part II. discusses the equipment of a small laboratory, and in Part III. directions are given for conducting a few experiments, and much space is devoted to mechanical devices.

The book has been most carelessly written, and abounds in errors, many of them serious ones. Some of the figures are bad and show the very defects of unobservant students' sketches, that science masters always guard against. Thus, all delivery tubes are indicated penetrating far into the vessel from which the gaseous product is to be led. An absurd distilling apparatus is shown on p. 87, and fig. 41 indicates precisely the wrong way to pour hydrogen.

The "most practical" method for removing tops from bottles is stated (p. 112) to be by plunging a red-hot iron into kerosene, with which the bottle is filled the desired height!

Among incorrect symbols and formulæ may be noted:—Magnesium *Mn*, Mercury Hq, Sodium Nitrate $NaSO_4$, and Alcohol $C_6H_{12}O_6$.

To introduce the Electronic Theory and Atomic Numbers to young students as the author has done is excellent, but this book cannot be recommended because it contains so many serious mistakes. J. G. F. D.

The Analysts' Laboratory Companion, by ALFRED E. JOHNSON, B.Sc. LOND., F.I.C., A.R.C.Sc. I. Fifth Edition. Pp. IX + 176. London: J. and A. Churchill, 1920. Price 10s. 6d.

In this edition (the fifth), the author has adopted the International Atomic Weights for 1921, and has recalculated, where necessary, various factors and data. Other improvements are also noticeable. But the information on particular branches of applied chemistry are dealt with rather too briefly to be of adequate service, although industrial chemists would naturally consult special treatises rather than this handbook for detailed information on any branch of the subject.

Analysts and works chemists will, however, continue to find this small but convenient Laboratory Companion very useful.

J. G. F. D.

Electro-deposition of Metals, by DR. GEORGE LANGBEIN, translated, with additions, by WILLIAM T. BRANNT. Eighth edition, revised and enlarged. Pp. XII. + 863. London: Hodder & Stoughton, Ltd., 1920. Price 42s.

This eminently practical work has now reached its eighth edition, which will be as popular among those engaged in electroplating and allied industries as its predecessors have been.

Most important innovations have received due attention, but the author seems to have taken much of the new matter from a few journals rather than from the whole literature on the subject. The same applies to the types of plant shown.

The historical and the detailed practical sections are well done, and leave little to be desired except that temperature is still given in the Fahrenheit scale. Some of the definitions (*e.g.*, that of "acids"), in the theoretical section, could be improved upon. Oxygen is given, instead of nitrogen, as a tri- or quinqui-valent element on p. 40.

An appendix contains useful electro-technical and general information.

The volume is primarily intended as a ready reference book and practical guide for the electroplater, but is also written from the scientific standpoint so that no reference library can afford to ignore it.

J. G. F. D.

SOCIETY OF DYERS & COLOURISTS.

Continued from May 12th.

We are long past the time of rule of thumb methods, and it is now more and more realised that the laboratory must work hand in hand with the producing side. The range of the chemists' activities is a fascinating one, not only on the industrial side, but also in the evolution of means of alleviating and preventing diseases to which all flesh is heir, and in the production of chemicals to assist an already bounteous nature. No industry affords better facilities than dye manufacturing for the development and training of chemists in this glorious work, and I am firmly convinced that British chemists are at least the equal of any chemists in the world.

I will now refer briefly to a few of the problems affecting our industry, and I cannot resist referring very slightly to a delicate subject, I might say a very delicate subject: that foundling known as the Safeguarding of Industries Act. This unfortunate foundling, discovered by Mr. Baldwin on the steps of the Board of Trade, has had during its short career on this uncharitable world a disastrous babyhood. Volumes have already been written on its diseases, and it has several times been operated upon by that well-known surgeon, the Referee, and I thin kwe may reasonably expect its early demise.

The Dyestuffs (Import Regulation) Act, 1920, which came into operation in Jan., 1921, deals with a most difficult and vastly complex problem. Many diverse views are held on this Act: the perspective entirely depends upon the spectacles one is looking through. The four main points of view to be considered are those of the Government and the Board of Trade, the British Dye Manufacturers, the foreign dyestuffs agents, and the users; and I will endeavour to put before you their respective views as they appear to me.

The Government still adheres to the opinion that for national security it is essential that synthetic colour-making factories should be maintained in operation in this country with their staffs of chemists and other experts. They are also of the settled opinion that this should be brought about without placing the textile and other colour-using industries in an unduly disadvantageous competitive position.

The British colour-makers' point of view is that without the Act they would be, if you will excuse me using the term, "wiped out," the depreciated mark at the present time making competition with the Germans absolutely impossible. They very naturally point out that the German Cartel, the "I.G.," in this event would practically have the market at its mercy and it could put up the prices, and seriously cripple the colour-using industries of this country. They also contended that so far they have not had a real chance to make good, as, owing to the large stock of German dyewares taken as Reparation, the stock that came into the country between the Sankey award and the passing of the Act, the large stock held by agents and users owing to the slump in trade, and the continued depression during last year, they have not had the advantage of the orders in bulk so essential for gaining experience and for economical production.

The Importing Agents for foreign firms naturally are against the Act, because it prevents them dealing with dyewares, except in a minor degree under licence; and so their means of livelihood are jeopardised.

The users, the most important body affected, view the whole subject with great anxiety and concern. Great Britain's textile trade alone, in 1920, represented over 50 per cent. of our total export of manufactured goods, and in 1921 over 40 per cent. Many colour users take the broad view that both for national and industrial security never again must the nation find itself in the terrible position it was in in 1914, but they ask that this should be brought about without placing them meanwhile in an unduly disadvantageous competitive position.

Others, I think a small minority, want to have the opportunity of taking advantage of the depreciated mark, and letting the future take care of itself.

Amidst all these divergent views it is essential that we must not lose the substance for the shadow. The export textile trade was built up on the quality and cheapness of its productions, and the trade will not regain its world supremacy until these two outstanding factors are re-established.

The quality of the dyestuffs played an important part in reaching that standard, and nothing should be done that will jeopardise our position in this respect.

We must be in the forefront in novelties and in the qualities of the dyewares applied to our textiles, and at the same time the prices for these wares must not be such as will retard the great efforts the textile trade is now making to re-establish itself in the world's markets.

This great nation during the war showed the world by its courage, its ability, its organising power, what it could do when hard pressed, it only needs the same unity, the same singleness of purpose to place the organic chemical industry on a plane equal to that of any other country.

Mr. Clare Lees (President of the Manchester Chamber of Commerce) proposed the toast of "The Textile Industry." He said:—The President referred to the Overseas Department over which Sir Philip presides, and I should like to add my voice to his, speaking on behalf of the commercial life of Manchester, not only in appreciation of the work of that Department, but in gratitude for the great assistance which it constantly renders to us. We are in constant communication with the Department, and we have received it in such a manner that it has always encouraged us to go again on any pretext whatsoever.

I do not think that anybody could suggest at the present moment that the textile industry is in a really satisfactory condition. If we compare the textile industry of 1913 with 1921 we find that we did not export in yardage, which after all is what matters to the working people of this country, more than one-half of our former production, and so we have a long journey to travel before we get full employment for our people, and after all that is the vital question for this country to-day. The cotton textile industries largely depend upon the condition of trade with India, and India has unfortunately fallen from her high estate in her transactions with Manchester. She bought very largely when goods were dear, and unfortunately something almost amounting to national repudiation took place, and the merchants of Manchester have been left with at any rate upwards of 30 million pounds sterling of bills that have not been taken up; and we in Manchester expect some settlement of those outstanding liabilities at the earliest possible date.

It must be remembered, and this is a thought on the brighter side, that no markets, whether they are rich or poor, will continue to buy on constantly falling prices. We have been going down hill in prices for nearly two years. Every time anybody has bought anything, by the time they got it

they wished they had not bought it. That process has been going on until the springs of legitimate speculation have dried up. Trade is very dependent upon speculation in its wise and legitimate form, and it is always a fact that speculation does enter as a corrective when markets are fluctuating by rises and falls. But when the fall is continuous you prevent that operation, and buying which in normal times would take off the temporary surplus in anticipation of better times, ceases. Values are fixed, after all, by a concensus of opinion, and the concensus of opinion has been that it was better not to buy. Now I suggest, and I think that this is a legitimate and a hopeful side to take, that that process cannot go on indefinitely. The time must come when the tide will turn, and as soon as ever the world realises that we have reached something like stability of values, perhaps with some slight tendency towards an upwards movement, those factors will again reassert themselves. There is another factor which has been of great disturbance to our trade, the poverty of Europe. We have ceased to buy food products to the extent of six million tons from certain groups of nations, and there has been a transferrence of four millions out of that six to another group of nations, and two millions we have not bought at all. In 1914 we derived 30 per cent. of those food products from Europe, and in 1921 that had fallen to 7 per cent. In 1914 we only derived 16 per cent. of those food products from the United States of America. In 1921 that had been raised to 32 per cent. Thus we have been forced to buy our food supplies from those nations that do not want, and will not have our manufactured articles. The result is that we are building up an increased indebtedness in that part of the world which is to our greatest disadvantage to be indebted to, and we are not able to send back in payment our manufactures.

There, I think, we have the textile trades' troubles more or less in a nutshell, and we are looking with earnest eyes and hopeful hearts to that great Conference in Genoa.

Speaking for a moment on the pending question of the wages in the cotton trade, what one has to bear in mind is the fact that the economic laws and moral laws are always ultimately in harmony. It is the function of the leaders of both sides to recognise this fact, and to translate it into concrete action. The markets of the world are the ultimate arbiters of all questions of employment both in regard to quantity and to wages. If the cost of production is relatively higher than the value of the commodities which the world has to sell us, then they will either take less in quantity or we must take lower prices. It is the duty of employers to get the best wages the trade can stand for their work-people, and alternatively it is the duty of the workers to meet the facts of world commerce. The purchasing power of the overseas market and our costs of production must be equated before we can hope to have full employment. If both sides approach this question from this point of view, a speedy settlement of their outstanding differences will ensue to the benefit of the country as a whole, and such a settlemeut will redound to the credit of both sides. It is not a question of one side gaining an advantage over the other, but rather of all agreeing to act in the highest interests of the trade as a whole.

Col. F. H. McConnel (President of the Textile Institute) said:—One thing shines out above all others in these very troublous times, and that is the heroic way in which both masters and men have met their difficulties and smiled through them. Happily on a great many sides we can see signs of brightness. Stocks are being rapidly dissipated. From India, where there has been so much trouble in getting goods taken up, considerable orders are being placed, and there are other hopeful signs. But it is no use being optimistic unless we d oour level best to earn the good times which are coming.

What we need is courage, confidence, and above all security.

The textile trade has its special difficulties. We know how the Indian Tariff is likely to affect, at any rate, the cotton industry. We know how the great export of machinery to India and to other parts of the world must have a serious effect upon the staple trades of this country. We have to meet that. We shall have to work hard to get over our difficulties. Sometimes the emplopers say, "Give us more production." No doubt production is an important thing, but its chief importance is the matter of reducing the cost of the articles so that they may be distributed over the world in greater quantities and with greater profit to the producers. Mere quantity can, however, be produced by those foreign countries who are getting our machinery

and have cheap labour. We must not be content with urging others to work and bring about more production, but we who have the leadership of industry must ourselves produce more from our brains, must try and raise the character of our industries and by enhancing the quality, by improving the design, by enriching the colouring of our textiles, provide work for the millions of producers. We may look with pride upon the way in which the workers have been working in this cruel time. In my opinion, great benefits can be secured by profit-sharing. In a concern of which I am a director, it has worked with extraordinary success, and there is a happy feeling between the workers and the employers which I attribute very largely to the Works Council and the Profit-Sharing Scheme, which has given them confidence that when good times come they will get their fair share of profits. It has also developed a real instinct for working with a better ideal of the functions of the worker, whether he be the manual worker or the man who works with his brain.

The Textile Institnte, of which I have the honour of being President, is one which groups together the scientific work of the different textile industries. We have always pressed forward the work of research, and it is with the greatest pleasure that we see the establishment of the various Textile Research Associations. It can easily be seen that many things, such as power, mill-driving gear, fatikue, labour, etc., are practically identical in the different branches of the textile trade, and it is of the greatest importance that the Textile Institute links those together and tries to keep before it a high standard of what the textile industries should be doing; not only working for profit but working for the benefit of the workers as well as the employers. Attention is being paid by the Hesearch Association to the details of the structure and the manipulation of the different fibres—cotton, wool, flax, silk, and so on—in a way that has never been attempted before and must lead to wonderful results in due time. But, in addition to those established fibres, there must he a great deal of effort made to produce improved artificial fibres, and it is up to the Society to do its part in enabling the best results to be got from all these fibres. To my mind, we should go about this in no insular way, but that all that is found out in this country, Germany, America and France should be worked together in the brotherhood of science.

Dr. M. O. Forster, in proposing the toast stuffs Importation Act, 1920, and said:—I confess quite frankly that my own sympathies are strongly in favour of the dye-makers, because I would go so far as to say this: that if the organic chemical industry of this country, which is represented mainly by the colour works, is allowed to go to the wall, if through any misinterpretation of the immediate economic requirements of the textile industry, that industry is allowed to die, then this country deliberately shuts itself out from any possible discoveries in chemistry, particularly organic chemistry, which may arise. That is a situation which no serious minded citizen of this country dare face. Think for a moment what that means. It means that such a revolutionary situation as occurred in 1856, when aniline dyes were first discovered, might easily arise during the next few years; and this country would have to follow the lead of Germany, France, or some other country which happened to come to the forefront in that direction. I say at whatever cost to even such an important industry as the textile industry, this country cannot afford to risk the colossal debacle following the loss of a revolutionary discovery.

The President suitably responded, and the proceedings terminated.

VENTILATION.

Two important papers on ventilation were recently read before the Institution of Mining and Metallurgy. The full papers can be consulted in the Library of the Institution.

The Index of the papers is given below:

Etude du régime des températnres dans l'épaisseur d'un mur indéfini dont les deux faces sont soumises à une même variation périodique de la température. (Study of prevailing temperatures in the interior of an undeveloped wall, those two faces are subjected to the same periodic variation of temperature.) J. Seigle. — Revue de l'Industrie Minérale, St. Etienne, March 15, 1922, pp. 135-45. 8 francs.

Physiological principles governing ventilation when the air is contaminated with carbon monoxide. (Apart from one important exception, carbon monoxide is an inert and non-poisonous substance; experiments on men in six cubic metre chamber; observations in large gassing chamber; rule of half equilibrium value in one hour; comparative toxicity of pure carbon monoxide and other gases.) Y. Henderson and H. W. Haggard.—Journal, Industrial and Engineering Chemistry, New York, Vol. 14,

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

11983—Baddily, J.—Dyes of the anthraquinone series. April 28.

11990—Moulder, C. H.—Treatment of xanthorhœa gums for production of dyes and stains. April 28.

11589—*Pettigrew, G.—Saturator for continuous* production of neutral sulphate of ammonia. April 25.

Specifications Published this Week.

157,745—Brat, P.—Process for recovering nitrogen in the form of ammonia and the like.

165,767—New Jersey Zinc Co.—Manufacture of zinc-oxide.

Abstract Published this Week.

Chemical Reactions.—Patent No. 176,438.—Mr. J. S. Morgan, of Messrs. Thermal Industrial & Chemical Research Co., Ltd., of 52, Grosvenor Road, London, has Patented a new method of effecting chemical Reactions.

Reactions in solid, liquid, and gaseous substances, which are liable to disturbance by exothermic heating, are effected by heating the finely divided substance or mixture of substances by passage through molten metal kept at a suitable temperature. by the rapid distribution of any locally-developed heat to the molten metal, undesired secondary reactions are avoided. Examples of reactions to which the invention may be applied are the destructive distillation of wood, the oxidation of methane to formaldehyde, and, according to the Provisional Specification, the distillation of calcium acetate, thus, finely subdivided wood such as sawdust or shavings are fed to a bath of molten lead at 350° C., and caused to travel therethrough by a rotating drum or by means of a travelling endless band, as described in Specification 174,974; a mixture of methane and air or oxygen is passed in the form of fine bubbles through molten metal heated to 350-400° C., preferably in the still described in Specification 170,617, the mixed gases being pumped into the hood and *issuing therefrom as* fine bubbles into the corrugations of the inclined plate.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3242.

JOURNAL OF SCIENTIFIC INSTRUMENTS.

A preliminary number of a new publication, entitled the *Journal of Scientific Instruments*, has been sent to us for notice. It is proposed that the Journal shall be published by the Institute of Physics, and will be edited by E. H. Rayner, Sc.D., assisted by an influential Advisory Committee. The object of the paper is to assist the worker and user of instruments of precision, and it will deal exhaustively with the science of measurement.

The scheme was originated by Sir Richard Glazebrook, who realised the importance of the subject in Science and Industry.

The present issue contains a number of very important papers, reviews, abstracts of patents, and a very long list of "Articles in Prospect."

The "Foreword," by Sir J. J. Thomson, O.M., F.R.S., President of the Institute of Physics, which we have pleasure in publishing below, gives the aims, objects, and hopes of the new venture.

Foreword.

It has long been recognised by many workers that a journal dealing with methods of measurement and the theory, construction and use of instruments would have a great value as an aid to research in all branches of science and industry. There is at present no publication in the English language which covers this ground. Descriptions of instruments and methods of measurement are given in journals devoted to particular branches of science; but in such publications results are of primary importance, and little space can be afforded to descriptions and detailed drawings of instruments. It frequently happens that instrumental methods are valuable for researches of quite a different character from that for which they were developed, and workers who may be interested in apparatus as distinct from results obtained never see the publication in question, even if they know of its existence.

It is proposed that a journal on the lines suggested shall be produced by the Institute of Physics, which will ensure that the management shall be absolutely independent. It will be managed by a Finance Committee appointed by the Institute, on which the Department of Scientific and Industrial Research and the National Physical Laboratory will be represented. The editorial work will be done at the National Physical Laboratory, assisted by a scientific Advisory Committee appointed by the Institute of Physics.

The expenses of the Journal will necessarily be considerable, as a high standard must be established and maintained, and it is doubtful whether receipts will cover expenditure, at any rate to begin with. Neither the Institute of Physics nor the Department of Scientific and Industrial Research has funds available to meet a deficit. Steps are being taken to raise a guarantee fund for the purpose.

Before it can be finally decided to publish the journal, it will be necessary to have some indication as to its probable circulation, and readers of this number are asked to notify their intention to subscribe on the accompanying form. It is proposed that the journal be issued monthly, and be similar in style to this preliminary number. The price will be 2s. 6d. (postage 2d. extra), or 30s. a year, post free.

It is estimated that with a circulation of about 1,000 there will be a deficit of some £2,000 per annum, while a circulation of about 3,000 will render the journal self-supporting.

Further particulars of the proposal are given later, together with specimen articles and a list of writers who have already expressed their willingness to contribute to the journal.

J. J. THOMSON,

President, Institute of Physics.

THE PREPARATION AND PROPERTIES OF ORGANIC STANNO- AND STANNI- CHLORIDES.—PART IV.: SOME DIAMINE STANNICHLORIDES.

By J. G. F. Druce, M.Sc., A.I.C.

The stannichlorides of *m*- and *p*- phenylenediamines have been previously described in Part II. of these researches (*Chemical News*, 1919, CXVIII., 90), where it was also stated that no double tin salt of *o*-phenylene-diamine had been isolated.

It has now been found that other diamines readily form stannichlorides, which exhibit the general properties of this class of double salts.

The corresponding stannochlorides have not been thoroughly investigated. They were not obtained by crystallising acidified aqueous solutions of the base and stannous chloride in molecular proportions. In the cases where crystals were obtained, these consisted largely of either the diamine hydrochloride or the stannichloride which was formed from the stannic chloride produced by oxidation of the stannous chloride on exposure to the air. Diamine stanno-chlorides appeared to be much more soluble than the corresponding stanni- salts.

It has been found possible to prepare stanno-chlorides of diamine bases by using solvents other than water. Results of experiments in this direction now in progress will be communicated upon completion.

The diamine stannichlorides are crystalline and dissolve in water with partial hydrolysis, giving acid solutions which deposit hydrated stannic oxide on keeping and on heating. They yield clear solutions with dilute mineral acids, and can be conveniently recrystallised from hydrochloric acid. Alkali solutions decompose them with liberation of the free base. Alcohols and acetic acid are the only common organic solvents that sometimes dissolve these substances.

The isolation of methylenediamine stannichloride has been accomplished, and from this substance the diamine hydrochloride was obtained, but the free base has not yet been isolated. Few simple derivatives of this substance are known. Einhorn and Mauermayer (*Ann.*, 1905, CCCXLIII., 310) isolated the bis diethyl acetyl derivative,

$$CH_2 \begin{cases} NH.CO.CH(C_2H_5)_2 \\ NH.CO.CH(C_2H_5)_2, \end{cases}$$

but nothing less complex appears to have been prepared previously.

The behaviour of hexamethylene tetramine towards chlorostannic acid, H_2SnCl_6 was investigated in the hope that it might assist in finding a correct formula for this substance (compare *Hahn and Walter* Ber., 1921, LIV., 1,531).

Hydrazine Stannichloride $(NH_2)_2H_2SnCl_6$.

Hydrazine mono-hydrochloride (2.. grms.) was dissolved in 50 cc. of hot dilute hydrochloric acid containing 11.7 grms. of crystalline stannic chloride. The solution was concentrated, and on cooling, thin colourless nacreous plates separated. These crystallised unchanged from dilute hydrochloric acid. The salt had not melted on heating, when a temperature of 300° had been attained.

On analysis,

0.3530 grm. gave 0.1470 grm. SnO_2;
Sn = 32.8 per cent
0.3668 grm. gave 0.8660 grm. AgCl;
Cl = 58.35 per cent
$N_2H_4:H_2SnCl_6$ requires Sn = 32.5 and Cl = 58.2 per cent.

Methylene-diamine Stannichloride, $CH_2(NH_2)_2.H_2SnCl_6$.—The methylene di-iodide required for this preparation was obtained in 15 per cent. yield by the method described by Gutmann (*Ber.*, 1919, LII. 212).

Stannous chloride (2 mols.) was dissolved in sodium hydrate solution and iodoform (one mol.) was added. The mixture was gently heated under a reflux condenser for two hours. By this time the iodoform had been converted into methylene di-iodide according to the equation:—

$$CHI_3 + NaHSnO_2 + 2 NaOH =$$
$$CH_2I_2 + NaI + Na_2SnO_3 + H_2O.$$

Methylene di-iodide was washed till free from alkali, and then distilled. The bulk boiled at 178-180°, and eight grams of this were mixed with 25 cc. of a strong aqueous solution of ammonia. The mixture was shaken periodically during several days until the di-iodide had disappeared. The vessel was then unstoppered and gently warmed on a waterbath at 40-50° to facilitate the evolution of the excess of ammonia.

The residual liquid was acidified and warmed with dilute hydrochloric acid containing 12 grams of crystalline stannic chloride. On cooling, a mass of fine crystals separated, which were quite distinct

from the octahedral ammonium stannichloride. When the salt was recrystallised it again gave a mass of small rhombic prisms. A small amount of the ammonium salt was obtained from the mother liquor, The salt dissolved easily in water, . . . but the solution hydrolysed on standing and on boiling. It did not melt when heated to 300°. On heating more strongly it decomposed, going slightly brown, with decrepitation and evolution of strongly acid fumes. A portion sublimed. When boiled with sodium hydrate solution it evolved an alkaline gas somewhat distinct from ammonia, which it closely resembled.

On analysis:—

0.5293 grm. gave 0.2062 grm. SnO_2;
Sn = 30.7 per cent.
0.3795 grm. gave 0.1514 grm. SnO_2;
Sn = 31.45 per cent.
0.3298 grm. gave 0.0456 grm. CO_2 and 0.1196 grm. H_2O; C = 3.77 per cent. and H = 4.03 per cent.
0.4500 grm. gave 1.0249 grm. AgCl;
Cl = 56.3 per cent.
$CH_2\ (NH_2)_2.\ H_2.SnCl^9$ requires
Sn = 31.3; C = 3.16;
H = 2.1; Cl = 56.5 per cent.

Ethylene diamine Stannichloride, $C_2\ H_4\ (NH_2)_2.\ H_2\ SnCl_6$.—Ethylene diamine hydrochloride (1.2 grm.) and stannic chloride (7 grms.) were dissolved together in 50 cc. of dilute hydrochloric acid. The solution was concentrated, and deposited very pale brown platelets which melted with decomposition at about 260°. The salt was readily soluble in water, giving an acid solution which became turbid on warming. When boiled with sodium hydrate solution ethylene diamine was evolved. The precipitate of *m*- stannic acid obtained dissolved in excess of the alkali.

In an attempt to prepare this salt from cyanogen, 5 grms. of silver cyanide were heated carefully, and the gas evolved was absorbed by 150 cc. of dilute hydrochloric acid containing 5 grms. of metallic tin. This solution was gently heated under the pressure of a few cms. of mercury until nearly all the tin had dissolved (20 hours). The filtered solution, which had a pale brown colour, deposited a small quantity of ethylene diamine stannichloride (0.8 grm.). The yield of the double salt was thus less than 12 per cent.

On analysis:—

0.7016 grm. gave 0.2832 grm. SnO_2;
Sn = 31.79 per cent.
$C_2\ H_4\ (NH_2)_2.\ H_2\ SnCl$ requires
Sn = 30.12 per cent.

Propylene diamine Stannichloride, $C_3\ H_6\ (NH_2)_2.\ H_2\ SnCl_6$.—This salt was obtained from the constituent simple salts dissolved in dilute hydrochloric acid in the quantities indicated by the formula.

The pale grey-brown short prisms darkened on heating at 260-270°. They possessed the characteristic properties of stannichlorides.

On analysis:—

0.3335 grm. gave 0.1203 grm. SnO_2;
Sn = 28.41 per cent.
0.3162 grm. gave 0.6613 grm. AgCl;
Cl = 51.7 per cent.
Sn = 29.16 and Cl = 52.2 per cent.

When a solution containing 4.52 grms. of stannous chloride and 3 grms. of propylene diamine hydrochloride in 100 cc. of dilute hydrochloric acid was concentrated $C_3\ H_6\ (NH_2)_2\ H_2\ SnCl_6$ requires and cooled, crystals of diamine hydrochloride separated. The mother liquor, on keeping, gradually deposited crystals of the stannichloride.

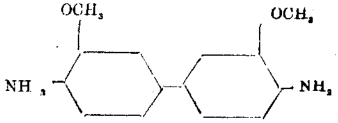
Benzidine Stannichloride, $NH_2 \cdot C_6H_4 \cdot C_6H_4 \cdot NH_2 \cdot H_2\ SnCl_6$.—This salt has been obtained from the constituent chlorides using excess of stannic chloride. As stated by Barnes (*Chemical News*, 1919, CXIX., 13), this substance is most conveniently prepared by the reduction of azobenzene.

Azobenzene (6 grms.) was reduced with 7.2 grms. of stannous chloride and 80 cc. of concentrated hydrochloric acid, diluted with an equal volume of water, by heating on a water bath for 3 hours. On cooling, a mass of colourless needles was deposited. These dissolved readily in warm dilute hydrochloric acid, but separated again on cooling. The salt dissolved in water, but the solution became cloudy. With glacial acetic acid, it underwent some change, and a white precipitate appeared. Alcohol dissolved it, but it was insoluble in other organic solvents.

On heating, it began to darken at about 250°, but was still solid at 320°.

When more stannous chloride than that indicated above was used together with strong hydrochloric acid, azobenzene was reduced to a violet solution which gave crystals coloured slightly green. These were found to be aniline stannichloride (compare *Chemical News*, 1918, CXVII., 347).

No stannichloride of dianisidine



has been prepared.

When hexamethylene tetramine (3 grms.) was added to stannous chloride (9 grms.) dissolved in 100 cc. of dilute hydrochloric acid, much formaldehyde was evolved. On concentration, the solution yielded colourless crystals which lost water on heating at 100°. When warmed with sodium hydrate solution they evolved ammonia. The salt was found to contain 35.3 per cent. of tin; 42.6 per cent. of chlorine, and 10.1 per cent. of ammonia. This corresponds with the calculated percentages for ammonium stannochloride, $(NH_4)_2\ SnCl_4.\ 2H_2O$.

By dissolving 3 grms. of hexamethylene tetramine and 14 grms. of stannic chloride in dilute hydrochloric acid, formaldehyde was evolved, and octahedral crystals of ammonium stannichloride separated when the solution cooled. Analytical results and other properties were in accordance with this conclusion.

The author's grateful thanks are due to Dr. A. Simek, Professor of Physical Chemistry at the Masaryk University, Brno, Czecho-Slovakia, who has secured the appended crystallographic data for the salts of propylene diamine, and *m*- and *p*- phenylene diamines, carried out by Prof. V. Rosicky.

Propylene-diamine-stannichloride:

Rhombic. a : b : c 0.81800 : 1 : 0.67366.

Forms:

m ...... (110) M* G**	} prevalent; sometimes give good reflexions.
o ..... (011) M., 01 G.	
b ..... (010) M., 0∞ G.	} narrow faces; b very often rather like a bright edge. Reflexions generally poor.
r ..... (021) M., 02 G.	

One circle goniometer measurements:

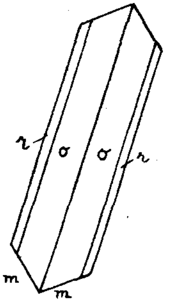
	Measured.	Calculated.
m : m = (110) : (1$\bar{1}$0)	= 78° 34′*	-
o : o = (001) : (01$\bar{1}$)	= 67° 56′*	-
o : r = (011) : (021)	= 19° 29′	19° 27′
o : b = (011) : (010)	= 55° 58′	56° 02′

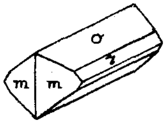
		ρ (measured).			ς(calcula
b	0	ca. 0° ¼′	89° 50′	0°	
	∞	50° 43′	90°	50° 43′	90
o	01	0°	33° 58′	0°	33°
r	02	0°	53° 29′	0°	53°

$p_o = 0.821.$

$q_o = 0.6747(2).$

Cleavage perfect according to (001) and (110). Highly birefringent. On (001) no distinct figure in convergent polarized light. Extinction on (001) parallel to the edges o : o. No perceptible pleochroism.





PROPYLENE DIAMINE STANNICHLORIDE.

p-Phenylene-diamine-stannichloride:

Rhombic, isomorphous with the foregoing salt. The crystals are less perfect, the faces reflecting badly, besides it was also broken and warped in general.

a : b : c 0.8187(3) : 1 : 0.6747(2).

Forms:

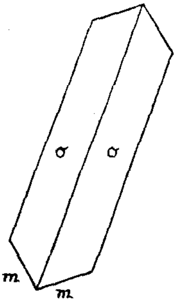
m ...... (110) M ∞ G.	} prevalent.
o ...... (011) M. 01 G.	
b ...... (010) M. 0 G.	} generally very narrow, like edges

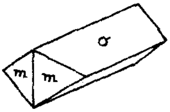
One circle goniometer measurements:

Two circle goniometer measurements:
m : m = (110) : ($\bar{1}$10) = 78° 37'*
o : o = (011) : (011) = 68° 01 *
Two circle goniometer measurements:

	(measured).		(calculated).	
o 01	0°	34° 01'	0°	34° 0½'
b 0_∞	0° 05'	90°	0°	90°
m ∞	50° 46'	90°	0° 41½'	90°

Cleavage and optical orientation the same as in the foregoing case. Distinct pleochroism on (001) parallel to a, brown-yellow, parallel to b, lightly straw-yellow.





p-PHENYLENE DIAMINE STANNICHLORIDE.

m-Phenylene-diamine-stannichloride: *Triclinic*. a : b : c 0.49771 : 1 : 0.67061, α=110° 14', β=99° 47½', γ=96° 15'.

Forms:

b	(010)	M.	0_∞	G. b, accor
m	(110)	M.	∞	G ding to
a	(100)	M.	∞0	G. whichthe
c	(001)	M.	0	G. crystals
o	(011)	M.	01	G. are tabu-

lar, prevails. a, which is a very good cleavage-plain, further o and c give excellent reflexions Of the faces b one is always better, reflecting perfectly and having a ribbed surface, the other is rugged (as marked by small-pox) and reflecting always poorly (pedial class?).

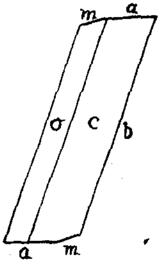
measured.

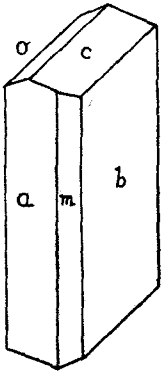
b : c	=	(010) : (001)	=	68° 10' *
a : c	=	(100) : (001)	=	77° 08' *
b : a	=	(010) : (100)	=	79° 33' *
a : m	=	(100) : (110)	=	25° 09' *
c : o	=	(001) : (011)	=	39° 21' *
a : o	=	(100) : (011)	=	83° 58'

calculated p_o 1.2718,
q_o 0.66579,
λ = 68° 10', μ = 77° 08'
ν = 79° 33'.

83° 58¾' a b c 32°

On b, 0 no distinct figure in convergent polarized light a black frame traverses the field. On a, 0, the acute bisectrix projects obliquely on the border of the field of view. One of the axes is visible near the border of the field, the other is passing already by it. The angle of optical axes is not too large. The extinction on b is oblique /, with respect to the edge b : c the angle is 32° against the obtuse angle β. On the cleavage face a the extinction is about 20° oblique to the edge a : b. *V. Rosicky.*





m-PHENYLENE DIAMINE STANNICHLORIDE.

* M = Miller.
** G = Goldschmidt.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MAY 18, 1922.

SIR CHARLES SHERRINGTON, PRESIDENT, IN THE CHAIR.

The following papers were read, the summaries here printed having been supplied by the Authors for use at the meeting:—

PROF. T. B. WOOD, F.R.S., and J. W. CAPSTICK, D.Sc. The Progress of Metabolism after Food in Swine.

Using a calorimeter recording electrically the main loss of heat by the animal, the authors have been able accurately to record the resting metabolism of a hog at intervals after feeding, varying from a few hours to six days. The results show that the excess of the resting metaholism above the basal, at any moment, is independent of temperature, weight, and age of animal.

This excess falls off according to the equation

$$\log y + A t = C$$

y being the excess, t time since meal, and A and C constants.

This equatiou is identical with that of Guldberg and Waage's Law of Mass Action, according to which the rate of decomposition of a substance at any time depends on amount of substance remaining undecomposed.

Simple analysis shows that this observation is consistent with the suggestion that the amount of the excess is dependent on the pressure in the body of a suhstance or substances, resulting from digestion and absorption of last or former meals, affecting the rate of metabolism, and in so doing being itself metabolised according to the mass-action law.

J. A. GARDNER and F. W. FOX. The Origin and Destiny of Cholesterol in the Animal Organism. Part XIII.—On the Autolysis of Liver and Spleen. Communicated by Sir W. Fletcher, F.R.S.

In a previous communication to the Society, the authors examined the intake and output of cholesterol in the fæces in the case of adults on normal diet, and found an excess of output over intake of ahout 0.3 grams per day. They, therefore, concluded that there must be some organ in the body capable of synthesising cholesterol. A similar... gunt, who expressed the opinion that this synthesis was a function of the suprarenal glands, but without giving much evidence for his view.

In 1920, Abelous and Soula studied the autolytic changes in the case of liver, spleen, nervous tissue and other tissues and organs, and, without giving details of their methods, published figures showing that on autolysis, spleen, and to a lesser degree, nervous tissue and liver, have the power of synthesising cholesterol. This synthesis is increased by the addition of cholalic acid. In other tissues than those mentioued, the cholesterol is destroyed during autolysis.

The authors have studied the autolysis of pulped spleen and liver, during periods varying from one day to a month, and are quite unable to confirm Abelous and Soula's results. The cholesterol content of tissue remains quite constant, within the limit of experimental error, during autolysis, and the addition of pure cholalic acid has no effect. So far as autolytic experiments bear on the question, they afford no evidence whatever that the organs in question have anything to do with either tbe synthesis or destruction of cholesterol in the organism.

C. G. LAMB. The Geometry of Insect Pairing. Communicated by Prof. J. S. Gardiner, F.R.S.

The paper deals with some cases of asymmetrical hypopygium found in certain dipterous families, and in other orders of insects. It is shown that such asymmetry would necessarily result if the usual vertical position of pairing was adopted, subsequent to a primitive linear position, in which definite correlation of the genital tubes had been established.

Certain terms are proposed for use in describing the various stages of pairing, and the movements required, in order to avoid the existing ambiguities in accounts of the phenomenon.

G. E. BRIGGS. Experimental Researches on Vegetable Assimilation and Respiration. XV.—The Development of Photosynthetic Activity during Germination of Different Types of Seeds. XVI.—The Characteristics of Sub-normal Photosynthetic Activity resulting from Deficiency of Nutrient Salts. Communicated by Dr. F. F. Blackman, F.R.S.

XV.—In a previous communication, it was shown that the photosynthetic activity of the seedling leaves of *Phaseolus vulgaris*

some time after their appearance, whatever external factor was limiting. Results of experiments by various workers on the growth of *Helianthus* suggest that such is not the case in this plant under natural conditions of carbon dioxide supply. As the result of experiments, it was found that the seedling leaves of this plant showed practically full activity immediately after germination, both when light and when temperature were limiting. Other plants were tested: some were like *Phaseolus*, and others like *Helianthus*. The differentiating feature is that, in the type which shows the lag between germination and development of photosynthetic activity, the seedling possesses a specialised photosynthetic organ separate from the storage organ, whilst in the type where there is no lag, the same organ serves the dual purpose. Thus, specialisation in this case does not confer any advantage as far as an early commencement of assimilation subsequent to germination is concerned.

XVI.—*Phaseolus vulgaris* was grown on a culture solution containing all elements necessary for plant growth, and in culture solutions devoid of potassium, magnesium, iron and phosphorus respectively. The assimilation of leaves from the plants was measured by determining their output of oxygen.

Two types of determinations were made. In both the partial pressure of the carbon dioxide was such that this factor was not limiting the rate of assimilation. In one type the intensity of illumination was so small that light was limiting; in the other, the intensity was increased until the rate was limited by temperature.

Under both conditions the photosynthetic activity of plants grown on culture solutions devoid of some one element was less than that of plants grown on normal solution. In each case the depression was the same when light was limiting as when temperature was limiting. This was established for the pinnate leaves as well as the primary entire leaves. Compared with plants grown in pots, the plant grown on normal solution did not show reduced photosynthetic activity until the pinnate leaves appeared. Other cases of such coincidence of sub-normality in both photochemical and chemical phases of the photosynthetic process are found scattered throughout the literature.

To account for the facts, the suggestion is put forward that the factor inside the plant which is involved in the process is the amount of "reactive chloroplast surface." Such a conception of the nature of the process demands that activity should be sub-normal when carbon dioxide is limiting, if it is when light or temperature is limiting. Evidence that such is the case is produced.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY, JUNE 1ST, AT 8 P.M.

The following papers were read:—

The reactivity of doubly-conjugated insaturated ketones. Part III.—Unsymmetrical hydroxy- and methoxy-derivatives.—J. S. Buck and I. M. Heilbron.

Phenopyryllium salts of distyryl ketones. Part I.—J. S. Buck and I. M. Heilbron.

ROYAL INSTITUTION.

The Friday Evening Discourse on June 9 will be delivered by Mr. Joseph Barcroft, on "Physiological Effects at High Altitudes in Peru."

GENERAL NOTES

THE INSTITUTE OF BREWING RESEARCH SCHEME REPORT II.

Research work of the Institute from May, 1921, to March, 1922, gives a brief account of the work carried out by the Institute during the period named. The account deals with the breeding of new varieties of hops, curing, chemical investigations, etc.

Work has also been done on the examination of timber used for casks, by Professor Groom, and many suggestions are given as to the suitability or unsuitability of a given wood. Details are also given of investigations by Mr. Hulton on the evaluation of barley from the nitrogen standpoint, and much valuable detail is included.

RAW MATERIALS REVIEW.

A new journal devoted to the subject of Raw Materials. Edited by Dr. Edouard Luboff, F.R.E.S. The Journal is launched with a series of short commendations by prominent men whose names are associated with national progress and advancement.

The first number contains articles on Minerals of the Empire, Raw Materials of Peru, Hide trade in British Malaya, Paper Making, and other important subjects.

Leading articles are given, dealing with Prices, Trade Statistics, and Miscellaneous Information.

The new Journal fills a distinct want, and if future numbers are as full of interest and valuable information as the first issue, the founder and editor may be sure of successful appreciation.

BOARD OF TRADE ANNOUNCEMENT. SAFEGUARDING OF INDUSTRIES ACT.

AWARDS IN ARBITRATIONS UNDER SECTION 1 (5).

Judgment has been given by the Referee in Arbitrations relating to the following complaints under the above Sub-section. The lists issued by the Board of Trade are amended in accordance with his Awards as from the 22nd May.

NATURE OF COMPLAINT.

(1) That Incandescent Gas Mantles are improperly excluded from the lists of dutiable articles.

(2) That Camphor (synthetic) and Pinene* are mproperly included in the lists of dutiable articles.

JUDGMENT.

(1) That the lists be amended by including therein "Mechanical aggregates of Oxide of Thorium and Oxide of Cerium and of Nitrate of Thorium and Nitrate of Cerium being ingredients of Incandescent Gas Mantles."

(2) "That Pinene* and Synthetic Camphor be removed from the list, and that the words 'Komppa's Synthetic Camphor' be added."

* *Note.*—Pinene has already been withdrawn from the lists by the Board as from the 6th April.

Board of Trade,
22nd May, 1922.

Messrs. William Hodge & Co., Ltd., the publishers of the Notable British Trials Series, announce for early publication a volume dealing with the trial of George Joseph Smith. This trial is popularly known as the "Brides in the Bath" case, and may be said to be without parallel in the history of crime in any age or country. The editor is Mr. Eric R. Watson, Barrister-at-Law.

ROUTLEDGE'S MODERN CHEMISTRY.

Messrs. George Routledge & Sons, Ltd., are preparing a series of volumes designed for the use of post-graduate readers and others who desire to be informed accurately as to the precise state of knowledge in the several departments of Chemistry to which they refer.

The contributors are teachers and workers of experience, and each is engaged in research connected with the subject of the volume to which his name will be attached. The information supplied will, therefore, be as nearly as possible in harmony with the actual state of knowledge and opinion at the time of publication.

The series is under the Editorship of Sir William A. Tilden, D.Sc., F.R.S., Emeritus Professor in the Imperial College of Science and Technology, South Kensington; and Professor J. C. Philip, D.Sc., F.R.S., Senior Secretary of the Chemical Society, and Professor of Physical Chemistry in the Imperial College.

Arrangements have been made for the issue of the following volumes:—

The Metastability of Matter, by Professor Ernest Cohen, of the Van't Hoff Laboratory, University of Utrecht. This will consist of a complete study of the changes formerly included under the term "allotropy," and the redistribution of energy involved in the many curious transformations of matter concerned.

Oxidation and Reduction in Organic Chemistry, by Oscar L. Brady, D.Sc. (Lond.), B.A. (Cape of Good Hope), F.I.C. of University College, London. The most important methods and the chief modern reagents will be described, and results achieved will be systematised and interpreted on the basis of present knowledge.

Physical Aspects of Organic Chemistry, by Professor T. M. Lowry, C.B.E., F.R.S., of the University of Cambridge. Professor Lowry has for many years occupied himself in observing the physical changes accompanying chemical reactions, and in studying the physical properties of organic compounds. Much more work will have to be done on these lines before the constitution of the majority of organic compounds is understood.

Atomic and Molecular Structure in Relation to Properties, by Dr. Irving Langmuir, of the General Electric Company, Schenectady, N.Y. The generally accepted theory of the constitution of an atom appears to be that all elementary atoms agree on having a central positively charged mass surrounded by a planetary system of electro-negative electrons. From the chemical standpoint the Lewis-Langmuir atom is particularly interesting, and this volume will constitute an authoritative contribution to a much discussed problem.

The Energy Factor in Chemical Change, by Professor J. R. Partington, M.B.E., D.Sc., East London College. This subject has received comparatively little attention in this country, and Prof. Partington's volume will supply a general introduction. Readers who have but a moderate mathematical equipment will find this volume valuahle as a guide in a highly important branch of modern chemistry.

Space Formulæ in Carbon Compounds, by Professor Jocelyn F. Thorpe, C.B.E., F.R.S., F.I.C., Imperial College of Science and Technology, associated with Dr. Christopher K. Ingold, B.Sc. (Glas.), A.R.C.S. This treatise will include discussion of the new views which have arisen in connection chiefly with the experimental researches of the authors.

Adsorption, by Professor J. W. McBain, Ph.D. (Heidelberg), F.I.C., F.Inst.P., of the University of Bristol. The phenomena of Surface effects have attracted much attention in recent years, but so far no general treatment of the subject has been attempted. A systematic treatment by a well-know worker of the somewhat complex material involved will no doubt be welcomed in many quarters.

The Theory of Quantitative Analysis and its Practical Application, by Proefssor Henry Bassett, D.Sc. Lond., Ph.D. Munich, D. es Sciences Nancy, F.I.C., University College, Reading. This volume will supply not only an account of the principle quantitative methods in actual use, but more especially the theory involved in such processes brought into harmony with modern views. Thus the strength of acids and bases, reaction velocities and the effects of various factors on solubility, &c., will receive special treatment and explanation.

THE BRITISH ENGINEERS' ASSOCIATION.

Engineering at the British Empire Exhibition, 1924.

The British Engineers' Association has been entrusted with the task of organising the Shipbuilding, Marine, Mechanical and General Engineering Section of the British Empire Exhibition, to be held in London in 1924.

The work of organising this imortant section and allotting space therein will be controlled by a special Committee composed of the President and Council of the Association, and a number of independent representatives of engineering industry.

Within the limits of the space available —about 238,000 square feet—every effort will be exerted to make the engineering exhibits representative of all that is best in modern British practice.

Full particulars, plans, and forms of application for space will be available for issue at an early date.

Enquiries should he addressed to D. A. Bremner, Director, The British Engineers' Association, 32, Victoria Street, London, S.W.1.

CHEMICALS AND "KEY" INDUSTRIES.

An interesting debate took place in the House of Lords last Tuesday, on a motion by Lord Beauchamp, to repeal the Safeguarding of Industries Act (which, among other things, places a duty on certain goods imported into this country, thus protecting "key industries"), on the ground that it interfered with trade and increased prices.

Lord Gorell, in reply, said that evidence showed that the Act had done much to encourage manufacturers in this country

not only to hold on to the position they had so precariously won, but also to undertake new developments. One old-established firm of chemical manufacturers had written:—"*For many months our factories were working short time. Had we been ruthless we should long ago have sacked large numbers of our people. As a result of the passing of the Act we have been able to put our factories on full time and re-engage practically all the hands we had been compelled to dismiss. We have found it possible to set to work on research and experimental work on a number of new products, which we believe can be profitably developed in this country under the protection of the Act. Without such protection it would simply not be worth while to go into them, as the Germans would most certainly have swamped us as soon as we had developed anything which they saw was in the least profitable.*"

Another firm had written:—"The first effect of the passing of this Act on us as *makers of fine chemicals was to establish* our confidence. Profits which had been hanging fire owing to the doubt which existed whether or not the Government would or would not actually give the necessary assistance to the immature fine chemical industry were proceeded with when the Bill became an Act. We have undertaken the manufacture of a large number of additional chemical substances since the Act was passed, and in many cases these are already on the market; in others—and this refers more to large scale manufacture—plant is in process of erection, and will shortly be working. We have three additional buildings at present in course of erection, two of them approaching completion. We are employing additional chemists, junior chemists, skilled workmen, process workers and labourers. Both as regards actual manufacture we have new work in hand which would not have been commenced but for the passing of the Act."

There were many other reports to the same effect, but he thought those two extracts were sufficient to show that at any rate the Act had been beneficial in increasing employment and enabling new and struggling chemical industries to be developed. Only in a few instances had the Act resulted in an increase of price. There was evidence to the contrary, and a number of chemical manufacturers had deliberately reduced their prices in order to take advantage of the Act and create a demand. This applied not only to chemical manufacturers, but also to certain classes of scientific instruments and scientific glass work. Further, the qkuality of some of the scientific goods made by British manufacturers was undergoing a marked improvement, notably with regard to the making of optical glass. In the short time it had been in operation, the Act had been a great success.

Lord Beauchamp's motion was defeated by 36 votes to 34.

Lieut.-Colonel Walter Guinness asked the President of the Board of Trade whether radium bromide was now subject to an importation duty under the Safeguarding of Industries Act; and, if so, whether he would take steps to remit this duty in the *case of all radium for therapeutic purposes?*

Mr. Baldwin replied: The answer to the first part of the question is in the affirmative. I have no power to take the action suggested in the latter part of the question.

CHEMICAL IMPORTS.

Mr. Baldwin informed Mr. Hogge that the following table referred to imports from October 1st to March 31st last:—

Commodity.	Unit of Quantity.	Quantities imported.	Declared Value thereof.
Cream of Tartar ...	Cwts.	2,755	14,760
Tartaric Acid	Cwts.	1,311	7,608
Citric Acid	Cwts.	122	1,618
Acetic Acid (including Acetic Anhydride)	Tons.	1,541	42,353
Vinegar and Acetic Acid for table use	Galls.	86,293	14,904
(R) Authracene ...	Cwts.	—	—
Tartaric Emetic	Cwts.	139	844
Calcium Ferrocyanide	Cwts.	39	199
(R) Naphthalene ...	Cwts.	584	332
Sodium Permanganate	Cwts.	—	—
(R) Ammonium Phosphate	Tons.	83	4,662
Potassium Permanganate	Cwts.	418	1,086
Sodium Acetate ...	Cwts.	1,188	1,340

THE INSTITUTION OF ELECTRICAL ENGINEERS.

19th May, 1922.

The result of the ballot for the election of Officers and new Members of Council for 1922-23 is as follows:—

President, Mr. F. Gill; Vice-Presidents, Dr. W. H. Eccles, F.R.S., Mr. A. A. Campbell Swinton, F.R.S.; Honorary Treasurer, Sir James Devonshire, K.B.E.; Ordinary Members of Council, Mr. J. W. Beauchamp, Mr. R. A. Chattock, Mr. F. W. Crawter, Mr. D. N. Dunlop, Major K. Edgcumbe, Mr. A. F. Harmer, Mr. W. R. Rawlings.

THE GEOLOGICAL SOCIETY OF LONDON.

May 19th, 1922.

The following communications were read:

1. "The Lower Carboniferous Succession in the Settle District and along the line of the Craven Faults," by Prof. Edmund Johnston Garwood, Sc.D., F.R.S., V.P.G.S., and Miss Edith Goodyear, B.Sc., F.G.S.

2. "The Miocene of Ceylon," by Edward James Wayland, Assoc.R.C.S., F.G.S., and Arthur Morley Davis, D.Sc., Assoc. R.C.S., F.G.S.

A meeting of the Society was held on Wednesday, May 24th, 1922, at 5.30 p.m., when the following Lecture was delivered:

"Geological Notes on Western Greenland," by Prof. A. C. Seward, Sc.D., F.R.S., President.

NOTES ON BOOKS.

Food Values, what they are, and how to calculate them, by Margaret McKillop, M.A., M.B.E. Pp. VIII. + 171. 1922, Second Edition (Revised and Enlarged). London: George Routledge & Sons, Ltd., Broadway House, 68-74, Carter Lane, E.C. 4. 3s. 6d. net.

An Introduction to the Chemistry of Radioactive Substances, by A. S. Russell, M.A., D.Sc. Pp. XI. + 169. John Murray, Albemarle Street, W.1., 1922. 6s. net.

The Tutorial Chemistry. Part II.—*Metals and Physical Chemistry*, by G. H. Bailey, D.Sc. Lond., Ph.D. Heidelberg. Pp. VI. + 494. University Tutorial Press, Ltd., High St., New Oxford St., W.C. Fourth Edition, 1922. 7s. 6d.

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

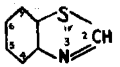
By Martin Meyer, B.Sc., M.A., New York City.

Introduction and Purpose.

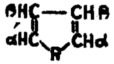
The chemistry of the organic sulphur compounds is one of the widest and most interesting divisions of the broad and attractive extent of the science, and in variety of properties, multiplicity of applications, and novelty of the reactions involved, is at least equal to, and certainly is excelled by no other. No matter what we choose as the criterion of our judgment we can meet all of the requirements without passing the boundaries of this field, be it medicinals, perfumes, dyes, explosives, or plastics, there is hardly a reaction that does not find its analogue, and in addition there are many here that can not be duplicated elsewhere.

In the chemistry of the dyestuffs, however, the sulphur compounds are pre-eminent. Of all the glorious colours which the chemist has contributed to mankind in his efforts to duplicate the iridescent beauty of the rainbow, the most beautiful and permanent are found in this group, the sulphides, the thioindigos, the thiazines, the thiazoles, and many others, the mere enumeration of which with their classes and sub-classes would fill a volume

Among the most interesting of all from both academic and commercial standpoints are the five-membered nitrogen and sulphur heterocycles, more particularly the six-five bicyclic ones, or benzothiazoles. Of these the simplest is benzothiazole, or methenyl base as it is termed by Hofmann, to which the indicated structure is assigned. It may be observed that two



arrangements of the atoms in the smaller ring are possible. The nomenclature of the typical five-membered heterocycle is given by Richter as follows:—



and in this system all of the compounds mentioned herein are substituted beta-thiapoles, the principal substitution being the incorporation of the alpha-beta carbon

atoms into a second benzol nucleus. The compound shown above is then benzo-beta-thiazole, and it is further suggested that for the sake of simplicity in nomenclature the positions in this be numbered as shown, which is also more in uniformity with the system applied to the thiazines and other heterocyclic compounds. This will be followed throughout this paper.

The homologues and derivatives of the compound just given offer a peculiarly attractive field for research, because of the variety of their properties and their commercial importance. To substantiate this statement without, at this point, going in too much detail, a few examples may be cited. By the fusion of benzanilide with sulphur, A. W. Hofmann prepared what he called benzenylortho - aminothiophenol. which in the system just recommended, is 2-phenyl-benzothiazole. The compound, wholly unlike any other known substance of its type, has a pleasant, highly aromatic odour, somewhat suggestive of tea-roses or geraniums, which led its discovered to term it also "Rosenkörper." Some of the derivatives of this series are dyes. A. H. Green, on fusing paratoluidin with sulphur, found primulin and dehydrothiotoluidin, which are well known because of their practical value, since the annual production of direct cotton dyes exceeds all others, being closely rivalled only by acid wool colours, and all the dyes of this group are direct cotton colours.

The last-named two substances are formed simultaneously in the same reaction, and it is an odd coincidence that while immediately after the original work, the former was the important product, today the latter is the more valuable. Nevertheless, in recent years comparatively little work has been done, or at any event, has been published, with them, and up to the present no entirely satisfactory method has been developed for preparing dehydrothiotoluidin in a state of purity, and the discovery of one would probably make it an even more important intermediate than it it. Further study of the reaction by which it is formed is therefore highly desirable.

With this brief introduction, the objects of this dissertation may be stated as follows:—

1. To make some further contributions to the chemistry of the benzothiazole group.

2. To derive a relation between the thiazole structure and tinctorial value.

3. To determine the relation between the thiazole structure and odour.

4. To prepare pure dehydrothiotoluidin (6 methyl 2 para-aminophenyl benzothiazole) and to separate it from the primulin simultaneously formed.

Historical Review of Previous Work.

Although the volume of research which has been accomplished in this field is quite large, and the compounds important, most textbooks omit it entirely or dismiss it with a few lines, and even the original papers do not give much information about other work. No really acceptable summary of all of the work has ever been published, and, as it would be very useful to new investigations in the group, it is this which has led to the rather complete form in which the history is presented. Furthermore, the second and third objects of this investigation make a knowledge of what compounds have been prepared, and of their properties essential, and these are given at the end.

The credit for the discovery of, and original work upon the compounds of this group belongs to August Wilhelm von Hofmann (born April 8, 1818, died May 5, 1892), one of Liebig's illustrious pupils, and without whose work organic chemistry, as we know it to-day, would indeed be much the poorer. As his biographers, Jacob Volhard and Emil Fischer, whose pre-eminence in chemistry needs no further eulogy, say:[1]

"Out of the great number of chemists who, come forth from Liebig's school in the second half of the last century, have made themselves useful as teachers and investigators in the broadening and advancing of our knowledge, August Wilhelm von Hofmann towers above all others in the number and importance of his discoveries, in the success of his teaching, in the fruitfulness of his influence on the chemical industry, and in the range of his directing influence as an author." Not the least among these were his researches upon the benzothiazoles.

In 1874, Sell and Zierold[2] succeeded in preparing isocyan - phenyl - chloride from phenyl mustard oil by the direct action of chlorine. A few years later Hofmann[3]

[1] Volhard and Fischer, *Berichte*, 35, 4502 (1902).

[2] Sell and Zierold, *Berichte*, 7, 1228 (1874).

[3] Hofmann, *Berichte*, 12, 1126 (1879).

conceived the idea of making the same substance from the mustard oil, using PCl_5, expecting that the reaction would take place in this manner:

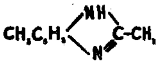
$$C_7H_5 + PCl_5 = C_7H_5NCl_2 + PCl_3S.$$

Upon actually performing the experiment he found that while some of the substance was indeed changed in this way, distillation of the reaction products yielded a portion boiling at 248° C. that contained a chlorinated mustard oil of a totally different type. The new substance was an oil of aromatic odour, B.P. 248° C., soluble in alcohol, from which it was precipitated by water, and upon a complete elementary analysis as a basis he assigned the empirical formula C_7H_4 NSCl to it. It did not resemble in the least the compound for which he had been looking, and he proceeded to investigate its reactions. By acid hydrolysis he obtained C H_4NS(OH) as a white solid (M.P. 136°, Jacobson later 139°), which exhibited phenolic properties, so he assumed the presence of an hydroxyl group. Dünner [4] had previously prepared hydroxyphenyl mustard oil which did not resemble this compound. The action of ammonia on the compound yielded the amine as an oil of aromatic odour, while aniline gave the anilide, a white, odourless solid (M.P. 159°). Although at this time he really did no work upon the structure of these substances, they were the first of the benzotbiazoles, for as he showed later, they are all 2-substituted derivatives.

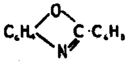
During the same year[5] Hoffman became interested in a different type of sulphur compound. Merz and Weith [6] had, by the action of sulphur on aniline, obtained a thioaniline which later proved to be identical with that prepared by Krafft[7] who demonstrated that it was a phenyl sulphide. It occurred to Hofmann that if, instead of employing aniline, he used benzanilide, or as he called it, phenyl-benzamide, in place of $NH_2C_6H_4$—S—$C_6H_4NH_2$, he should obtain a benzoylated thioaniline. On actually performing the experiment ne found a reaction quite different from his expectations, and prepared in this way a substance which crystallised from alcohol in colourless needles (M.P. 115° C.) and had a pleasant, fragrant odour, resembling tea-roses or geraniums. Analysis indicated the empirical formula $C_{13}H$ NS, and he showed the reaction by which it was formed to be:

$$C_{13}H_{11}NO + S = C_{13}H_9NS + H_2O.$$

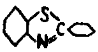
Hobrecker [8] earlier had synthesized a copound to which he assigned the formula



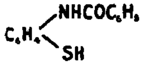
hy reducing nitro-acetorthotoluidid, and Ladenburg,[9] and lated Wund,[10] had prepared similar bases by the condensation of diamines with acids, and finally, studying the condensation of orthoaminophenols with acids, Ladenburg[11] had made a substance which he wrote



The analogy to his own case was immediately apparent, and Hofmann assigned the formula



to the "Rosenkörper." To establish this fact more definitely, he then proceeded to show that, as would be expected from its structure, it yields, on hydrolysis, ortho-amino-thiophenol and benzoic acid, and that it could be prepared from these two by the formation of an intermediate



This was the first compound of the group whose structure could in any sense be said to have been proved. He now went back to his oribinal chlorphenyl mustard oil and repeated his work, adding some more, and preparing a number of new compounds listed at the end of the section. Then realising that his previous article contained no proof of the structure o fthe chlor mustard

[4] Dünner, *Berichte*, 4, 465 (1871).
[5] Hofmann, *Berichte*, 12, 2359 (1879).
[6] Merz and Weith, *Berichte*, 3, 978 (1870).
[7] Krafft, *Berichte*, 7, 384 (1874).

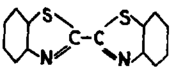
[8] Hobrecher, *Berichte*, 5, 920 (1872).
[9] Ladenburg, *Berichte*, 8, 677 (1875).
[10] Wund, *Berichte*, 11, 826 (1878).
[11] Ladenburg, *Berichte*, 9, 1524 (1876).
Ladenburg, *Berichte*, 10, 1123 (1877).

still further. By reduction with tin in concentrated hydrochloric acid, he obtained C_7H_5NS, a liquid, heavier than water and insoluble in it, soluble in ethyl alcohol and carbon disulphide, having a burning taste, and a characteristic odour resembling somewhat that of the pyridines and the plant bases. It is isomeric with the mustard oils and thiocyanates and forms an addition product with methyl iodide which is soluble in water from which it crystallizes in colourless needles. M.P. 210°. The new base reacted with benzoyl chloride—

$$C_7H_5NS + C_7H_5OCl = C_{13}H\,NS + CO + HCl.$$

This compound proved to be identical with that which he had previously obtained by the fusion of benzanilide with sulphur, and established beyond reasonable doubt, the structure of the new substances, which he then named on this basis. By this method he contributed further new compounds listed at the end.

Up to this time the only general method by which the benzothioazoles could be prepared, which was recognised as such, was that by which the just mentioned ones were prepared, that is, the condensation of ortho-aminothiophenols and acids, acid anhydrides, chlorides, and amides, but also in 1880 [12] he conceived the idea that the reaction by which "Rosenkörper" had been synthesized might be applied with appropriate changes to the synthesis of homologues. Immediately he proceeded to investigate the behaviour of anilides on fusion with sulphur, obtaining from formanilide a small amount of methenyl base or benzothiazole, from acetanilide slight quantities of ethenyl base, or 2-methyl benzothiazole, but much larger yields of a new substance which had the empiric formula $C_{14}H_8N_2S_2$, and to which he assigned on the basis of several syntheses the structure:



oxalaminothiophenol (2 :bis-benzothiazole [M.P. 306]). It crystallizes from alcohol in white needles although the solubility is very slight. No good proof of its structure was given, however, for several years.

Following this he prepared a number of the homologues of this compound, using the dibasic aliphatic acids and ortho-aminothiophenol. Only a year later Hess,[13] after having prepared the aminothiocresols, became interested in this general reaction, and using 3 sulphydroxy 4 amino toluene contributed several new compounds which will be given later.

Interest in these new sulphur compounds now became quite general. Two years after the work just described, Tiemann and Piest[14] succeeded in preparing the "Rosenkörper" by a new method, the fusion of phenylanilino acetic nitrile which they happened to be studying, with sulphur. They demonstrated that the reaction proceeded according to the equation:

$$C_6H_5CH(C_6H_5NH)CN + 2S = C_{13}H_9NS + H_2S + HCN,$$

and identified the product by its melting point and ultimate analysis.

Then in 1886 P. Jacobson [15] published the first of a series of important contributions to the chemistry of the benzothiazoles. Thiobenzaldehyde had already been prepared by Klinger [16] and from this thiobenzanilide, which was also prepared by Leo[17] (and later by Gatterman—vide experimental part), by heating with aniline, but in repeating this work and studying the products of the reaction (stilbene and thiobenzanilide) Jacobson found also some of Hofmann's "Rosenkörper." The only explanation that he could give for its formation was that of oxidation of the thiobenzanilide, and to test the validity of his reasoning he oxidised a portion in alkaline solution with potassium ferricyanide and showed that about 60 per cent. of the product was the expected phenyl-benzothiazole. A new method of synthesis had been developed, for he recognised at once the generalisation that could be drawn from this experiment, and proceeded to prepare the 2 methyl-benzothiazole, and claimed to have obtained thioanilides, though in the case of the last mentioned, he was later disputed by Hofmann.

Apropos of the thioanilides a rather curious coincidence may be mentioned. Leo

[12] [illegible]

[13] Hess, *Berichte*, 14, 493 (1881).

[14] Tiemann and Piest, *Berichte*, 15, 2033 (1882).

[15] Jacobson, *Berichte*, 19, 1069 (1886).

[16] Klinger, *Berichte*, 9, 1893 (1876). Klinger, *Berichte*, 10, 1877 (1877).

[17] Leo, *Berichte*, 10, 2133 (1877).

in a dissertation for his doctor's degree at Bonn, 1878, under the title of thioanilides, described a substance which he prepared by the distillation of thiobenzanilid in the presence of air, and to which he assigned the formula $C_{27}H_{20}N_2S_2$. From his observations of the properties of the substance it was evidently the "Rosenkörper," and if his analytical work had been a little more accurate, and he had been able to appreciate the significance of his discovery, the credit for the original work in this field would have gone to him, for his work appeared several months before Hofmann's first paper.

In 1887 [18] Hofmann published some further work on the chemistry of this series. He treated ortho-aminothiophenol with carbon disulphide expecting to find a derivative of thiocarbanilid, but obtained instead a body whose empiric formula was C H_5NS_2 and which he showed readily was 2-sulphhydrobenzothiazole and could be prepared from chlorbenzothiazole and sodium sulphydrate. By oxidation of this compound he made a 2:2 benzothiazole disulphide, shining, silvery plates from benzol, M.P. 180° (Jacobson later 186°), and by methylation the thioether, colourless prisms from dilute ethyl alcohol, M.P. 52°. The latter had an odour resembling that of benzothiazole itself, and also was quite similar to the ethoxy derivative already made.

[18] Hofmann, *Berichte*, 13, 1788 (1887).

(*To be continued.*)

THE ACTIVATION OF HYDROGEN BY THE SILENT ELECTRIC DISCHARGE.

By Y. Venkatarmiah.

Maharajah's College, Vizianagram, S. India.

Being curious to know the effect of the silent electric discharge on gases* other than oxygen, I submitted hydrogen to its action in the new ozoniser which was constructed in th is laboratory. Hydrogen is of particular interest, as it is a monovalent element. Curiously enough, certain experiments, which were conducted by the author, afford a good evidence to believe that hydrogen undergoes polymerisation under the influence of the silent electric discharge.

* W. A. Shenstone, J.C.S.Tr. 1897, p. 487. 'It appears, therefore, that highly purified chlorine remains almost unaffected by the ozonising discharge.'

The hydrogen which was utilised in the experiments was prepared by the electrolysis of a concentrated solution of barium hydroxide. The hydrogen thus prepared was passed over calcium chloride and phosphorus pentoxide, and then over lumps of potassium permanganate fused with potassium hydroxide and finally through the ozoniser. The whole apparatus was swept with hydrogen for some hours before the actual experiments were commenced. The ozoniser was worked by a powerful induction coil for the production of the silent electric discharge. After the hydrogen traversed the whole length of the ozoniser it passed over sulphur contained in a tube attached to the ozoniser. The hydrogen then finally passed over a strip of paper, in contact with a solution of lead acetate. In course of time the paper became black, showing thereby that the hydrogen from the ozoniser attacked the sulphur with the production of hydrogen sulphide. In a similar way it was found that phosphorus gave rise to hydrogen phosphide.

In order to confirm that the reduction of sulphur and phosphorus to hydrogen sulphide and to hydrogen phosphide respectively was not due to any other impurities in the gas, but the activated gas from the ozoniser alone, the gas from the drying and purifying chambers was passed directly over sulphur for a long time, but to no effect. Hydrogen from various sources was also tried, but no hydrogen sulphide was produced. It was also observed that any attempt to make the reactive hydrogen reduce sulphur after a few minutes of its activation was futile.

It is known that nascent hydrogen brings about reductions, but its action is only of a local character. The source and the reducible substance should be in contact with each other in order that the reduction might take place. But, from the foregoing experiments, it is clear that hydrogen activated in the ozoniser has a life of its own. It survives even after it leaves the locality where it is activated, though its life is short.

In these circumstances, it is not far from right to suggest that this new hydrogen is an ozone form of hydrogen. No doubt, it is difficult to picture a molecule in which three atoms of hydrogen are in 'Atomic Dance' with the present theories of valency at our back. The author is continuing the work in the laboratory. Hereafter he wishes to study the effect of a polymerising gas such as oxygen on the production of active hydrogen in an ozoniser.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications

12651—Bone, S. C.—Purification of saccharic solutions. May 4.
12629—Carpmael, W.—Manufacture of sulphur dyestuffs. May 4.
12764—Pedemonte, A. L.—Manufacture of aluminium sulphate and pure ammonia. May 4.
12726—Roiboul, M.—Manufacture of crucibles for fusing and casting refractory minerals. May 5.

Specifications Published this Week.

155,824—Fabriques de Produits Chimiques de Thann & De Mulrose.—Manufacture of anhydrous zinc sulphide.

Abstract Published this Week.

Anthraquinone Derivatives. — *Patent No.* 176,925.—Mr. D. Segaller, and D. H. Peacock, of British Dyestuffs Corporation, Ltd., Imperial House, Kingsway, have Patented a new process for obtaining oxanthraquinones and their homologues and sulphonic acids.

1-oxanthraquinone-4-sulphonic acid is obtained by heating phthalic anhydride and phenol or phenol-p-sulphonic in sulphuric acid containing boric acid at about 200° C; further heating of the 1-oxanthraquinone-4 sulphonic acid, after isolation or not, in sulphuric acid at 240-250° C. gives quinizarin; the production of quinizarin from phthalic anhydride and phenol may be effected in one operation; catalysts, such as mercury oxide may be added. If phenol-2-4-disulphonic acid is employed or formed, 1-oxanthraquinone-2; 4-disulphonic acid and purpurin are obtained. If phenol is replaced by cresols, the corresponding products are 1-oxy-2-methylan-thraquinone-4-sulphonic acid or 1-oxy-3-methyl-anthraquinone-4-sulphonic acid in the case of O-or m-cresol respectively, the final product in each case being 2-methylquinizarin; p-cresol gives directly 1-oxy-4-methylanthraquinone.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3243.

BRITISH COLONIES IN EAST AND WEST AFRICA.

Effect of Taxation upon Trade.

Sir,—I enclose a copy of a letter which has been addressed to-day by the Federation of British Industries to the Secretary of State for the Colonies, calling attention to the serious effect that the high level of taxation in the British East and West African Colonies is having upon trade between the United Kingdom and these possessions.

The burden of taxation is so great that it seriously impairs the purchasing power of the Colonies to the detriment of British export trade; and, at the same time, tends to discourage production on the part of the natives of those raw materials upon which so many industries in this country depend, i.e., cocoa, palm-kernels, copra cotton seed, bides, etc.

The Federation of British Industries, in their letter, suggest the formation in each Colony of local committees, after the nature of the "Geddes" Committee in this country, to examine and make suggestions in regard to reductions in expenditure leading to decreased taxation.

It has been arranged for representatives of the Federation of British Industries to meet the Secretary of State for the Colonies at the Colonial Office, on June 14th, with a view to further discussion on this subject.

Yours faithfully,

Sidney Rogerson,

Directors' Department.

G/1130A. Ref. 300/J/11.

30/5/22.

Sir,—The attention of the Federation of British Industries has been called to the grave depression of trade in the East and West African Colonies. While much of this depression is no doubt attributable to the general world conditions and consequent falling off in demand for the produce of those Colonies, there appears to be no doubt that this situation, already very difficult, is gravely aggravated by the heavy burden of taxation.

This burden not only directly diminishes the purchasing power of the native population, and consequently restricts the demand for British goods, but, by removing the stimulus and encouragement to production so necessary in the case of races which have only recently acquired habits of peaceful and steady industry, creates a grave risk of permanently impairing the exporting capacity of the Colonies, upon which both their prosperity and their capacity to absorb British goods ultimately depends.

The primary cause of this taxation appears to be the greatly increased expenditure undertaken both for development and administrative purposes since the war. The Federation fully realises that much of this increase may have been, as in other parts of the world, the inevitable result of post-war conditions, but after a general examination of the facts they cannot escape the conclusion that an unduly optimistic estimate of the revenue-producing capacity of the Colonies concerned was formed during the boom period of 1919-1920, and that this optimism led to the adoption of a scale of expenditure and consequently of taxation possible during such a boom period, but impossible during the present world depression.

They therefore wish to urge most earnestly upon you that immediate steps should be taken to consider carefully all the problems connected with expenditure in these Colonies, with a view to its reduction and a consequent reduction in taxation.

In the first place they would desire to express approval of the step already taken in the Kenya Colony of establishing a Committee including representatives of unofficial commercial interests for the purpose of advising the Government; and especially of the prompt steps which have been taken on the advice of that Committee in order to reduce expenditure and taxation.

They trust that the good work done by this Committee will be continued and extended by the appointment of similar Committees in the other East African Colonies, and they desire to suggest that a somewhat similar course should be pursued in regard to the West African Colonies.

As the local circumstances in the different colonies differ to some extent, as also do the fiscal arrangements in force, they would recommend that a separate local Committee, representative of both official and commercial interests, should be set up in each Colony, which should be empowered to recommend immediate reforms to the Government of the Colony, and also to submit

to the Colonial Office suggestions for further and more far-reaching reforms. A further Committee, also representative of both official and commercial interests, might be set up in this country to advise the Colonial Office upon questions of principle and upon the recommendations forwarded by the local Committees.

The Federation do not desire at the present stage to enter into matters of detail, but they consider that among other points which might well be considered by such a Committee is the desirability of postponing certain general schemes of development which were undertaken under the influence of the optimistic spirit engendered by the boom period, and the possibility of readjusting the financial arrangements made in connection with such developments as are continued, so that a larger proportion of what is in reality a capital expenditure should be met by loan funds, and a smaller proportion from annual revenue.

I am, Sir,
Your obedient servant,
R. T. Nugent,
Director.

QUATERNIAN SERIES AND ISOTOPES.

To the Editor of the "Chemical News."

Sir,—In the Chemical News (1913), 107, p. 247, I gave a quaternian series, comprising elements: H, Be, Cl, Ga; but, at that time, isotopes of the common elements were not known. Furthermore, the atomic weight of beryllium was not very accurately determined. Now that a more accurate determination of the atomic weight of beryllium has been made by Hönigschmid and Birckenbach (*Berichte*, 1922, 55, p. 4), which is 9.018, the series may be reconsidered in the light of this value and of the work of G. P. Thomson (*Phil. Mag.*, 1921, 42, p. 857) on the mass of beryllium from the isotopic point of view. Thomson finds that this element has no isotopes, that is to say, each one of its atoms has a mass of 9. It is now well known that chlorine has isotopes of masses 35 and 37. The atomic weight of gallium is now given as 70.1. The earlier recalculated value was 69.9, so that for the present purpose it is probable that the value of 70.0 will be near enough to the truth, since there may be isotopes.

The quaternian series may now be constructed out of these newer values so that the secondary differences are in geometrical progression—as in the case of the series beginning with argon, published in this Journal July 15, 1921, vol. 123, p. 38—

Element & At. wt.		Differences.	
Hydrogen	= 1.0		
		—8	
Beryllium	= 9.0		—18
		—26	
Chlorine	= 35.0		— 9
		35	
Gallium	= 70.0		

It is of interest to note that gallium (of Group III.) and beryllium (of Group II.) have masses which seem to violate the general rule of odd and even atomic mass harmonising with odd and even valence, or with odd and even atomic number. I am, &c.,

F. H. Loring.

THE SALTS OF ZIRCONIUM.

By John Missenden, B.Sc.

The conjunction of bromine with zirconium, as in the case of chlorine, forms two main compounds which are analogous to the chlorides, so that a more detailed description of their peculiarities will be deduced from that heading. *Zirconium bromide*, $ZrBr_4$, is a white crystalline powder which, on coming into contact with moisture, forms *zirconium oxybromide*, $ZrOBr_2$, a crystalline substance formed of sharp needles. Zirconium bromide may be easily converted into vapour at 187° C.

The chlorides form a better-known group. Of these, *zirconium chloride*, $ZrCl_4$, is the most common, and may be produced by treating the hot metal with either hydrochloric acid or chlorine. *Zirconium oxychloride*, $ZrOCl_2$, is produced with the evolution of heat when moisture is present. According to Weibull, the chloride may be also obtained by passing chlorine gas over a mixture of charcoal and zirconium oxide, ZrO_2 at a temperature of 235° C., but it is a matter of doubt whether he ever obtained it from the oxychloride. This last compound may also be produced by adding a solution of hydrochloric acid to some zir-

conium hydroxide, $Zr(OH)_4$. The resulting fluid should be allowed to evaporate, and crystals of the quadro-prismatic order will form. To these, Weibull gave the formula $ZrOCl_2:8H_2O$; and, by heating them to 50° C.,* basic oxychlorides may be formed. The hydrated oxychloride crystals may be recognised by having a sharp, sweet taste, and they are soluble in water.

Of the fluorides, *zirconium fluoride*, ZrF_4, is the most important. It is produced by heating a mixture of hydrogen ammonium fluoride, $NH_4F.HF$, and zirconium oxide, the equation being:

$$2NH_5F_2+ZrO_2 = ZrF_4+2NH_2.OH+2H_2;$$

the secondary products being hydroxylamine and hydrogen. After the removal of the former, a little dilute hydrochloric acid may be added, when the zirconium fluoride will combine with the water to produce crystals of the formula $ZrF_4.3H_2O$. *Potassium zirconofluoride*, K_2ZrF_6, may be prepared by a solution of zirconium fluoride being added to a considerable excess of potassium fluoride solution, the action being as follows:

* The writer has found that these crystals yield up 80 per cent. of their water to and at 36° C., the remainder being driven off gradually until all traces have gone at 57° C.

$$4KF + ZrF_2 = K_2ZrF_6 + 2K .$$

the remaining potassium uniting with the water. A second way is to fuse hydrogen potassium fluoride and hyacinth together. The equation is:

$$3KFHF+ZrSiO_4=K_2ZrF_6+KOH+SiO+H_2O$$

The zirconofluoride is soluble in water, the ratio of the volumes varying widely with the temperature in accordance with the following table:—

Temp. C.	No. of parts water.	Temp. C.	No. of parts water.
10°	81.75	60°	26.25
20°	64.50	70°	19.75
30°	52.00	80°	14.50
40°	42.25	90°	9.00
50°	34.00	100°	4.25

The salt produced my mixing zirconium fluoride and sodium fluoride, Na_2ZrF_6 4NaF, betrays the same peculiarities, but is far less soluble.

The carbides take two forms; that having the composition, ZrC, and that having the composition ZrC_2. The first, *zirconium monocarbide*, is prepared (Moissan) by heating in an electric furnace a carbon tube containing an equal mixture of zirconium oxide and charcoal. It is a fairly hard substance with a greyish-metallic appearance, and burns with a bright flame when heated in air. It is neither decomposed by oxygen nor water at normal temperatures. The second, *zirconium bicarbide*, is prepared in the same manner as the other, but it is necessary to have a considerable excess of charcoal present. This, too, has a metallic lustre, but it will not decompose when treated with water, even at high temperatures.

Zirconium nitrate, $Zr(NO_3)_4$, is capable of little investigation. It is produced by evaporating at 85° to 90° C. the liquid formed by mixing nitric acid with zirconium hydroxide; and takes the form of a yellow gelatinous mass.

Hyacinth (zircon), $ZrSiO_4$, belongs to the silicate group, and may be regarded as the chief source of zirconium, occurring naturally in granular limestone and crystalline rocks in general (*i.e.*, granite, gneiss, schist and syenite). It takes the form of the quadro-prismatic and quadro-pyramidic orders, and is colourless.

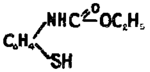
The sulphur group contains only two compounds of any note, a sulphide and a sulphate. The first of these, *zirconium sulphide*, ZrS, is formed when sulphur and zirconium are heated together in association with hydrogen, and it is a dark brown powder. If it is fused with potassium monoxide, potassium monosulphide and zirconium oxide are yielded. *Zirconium sulphate*, $Zr(SO_4)_2$, is a white substance which is possessed of the same properties as potassium zirconofluoride. It may be prepared by evaporating to dryness a mixture of sulphuric acid and zirconium hydroxide, and heating the residue to a dull red. The mixture of zirconium sulphate with the hydroxide forms a basic salt with the formula $Zr(SO_4)_2.ZrO_2$; while if alcohol be added to the normal salt, an insoluble substance, $Zr(SO_4)_2.2ZrO_2$, is precipitated.

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(Continued from Last Week).

In this paper he further developed two new methods of synthesis which, however, do not admit of general application, by preparing 2 phenylaminobenzothiazole by heating a mixture of anisyl and thioanisyl mustard oils, synthesized by the method of Mülthaüser[19] ; and by preparing the oxymethenyl base by distillation of the urethane



which he obtained from the mercaptan and chlorcarbonic ester. During the same year he conducted a research on naphthylthiazoles and prepared a number by methods similar to those already given. (Listed at the end.)

No very satisfactory proof of the structure of these compounds had appeared at any one time, though taking into consideration all the methods of synthesis which had been developed up to this time, there is little doubt left in the mind of even the most critical reader. In 1887, [20] however, Hofmann published a summary of the facts leading to the structural formulæ for the thiazoles, using as a case in point, oxalaminothiophenol. Hofmann's proof of the structure of oxalaminothiophenol may be briefly abstracted as follows:—

1. Its empiric formula from analysis is $C_{14}H\ N_2S_2$.
2. On hydrolysis it yields ortho-aminothiophenol and oxalic acid according to the equation:

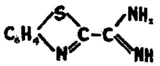
$$H_8N_2S_2 + 4HOH = 2C_6H_4\begin{cases}NH_2\\SH\end{cases} + H_2C_2O_4$$

3. It may be synthesized as follows:

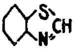
(a) By leading cyanogen into a strong solution of orthoaminothiophenol

$$2C_6H_4\begin{cases}NH_2\\SH\end{cases} + N\equiv C-C\equiv N \longrightarrow C_{14}H_8N_2S_2 + 2NH_3$$

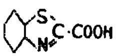
(b) By adding the mercaptan to an alcoholic solution we obtain amidin as a first product



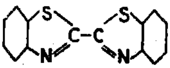
(according to Hofmann) which upon further treatment with the mercaptan yields oxalaminothiophenol. Amidin has two hydrogen atoms which are easily replaced by phenyl groups and must hence be attached to nitrogen atoms, and on treatment with KOH which would hydrolyze amides gives the potassium salt of an acid which upon liberation of the free acid breaks up into methenyl base. The latter may be synthesized from formanilid and sulphur, from thioformanilid by direct oxidation, and by condensation of orthoaminothiophenol with formic acid, all of which in consideration of his previous work, lead to the structure of methenyl base as methenyl base as



The acid must then have been



amidin, as given above, and the original ba



4. Now Bladin[72] working with orthonitroanilin had prepared an analogous series of compounds where the sulphur atom is replaced by an imido group, and had assigned a similar structure to his final product, although he arrived at somewhat different ones for the intermediate amidin and acid, and the formula agreed also with the work of Ladenburg (see previously) and others in related fields, so Hofmann believed his formula to be justified.

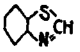
At the same time he reviewed the work of Jacobson, and contradicted the latter's statement that he prepared benzothiazole by the oxidation of thioformanilide, al-

19. Mülthaüser. *Berichte.* 13. 919 (1880).

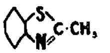
though he admitted that the ethenyl base could be obtained in this way.

At the end of this paper he made an interesting series of observations, and described a few preliminary experiments which should be a very fruitful field for research, and yet which it does not appear that he ever followed up, although he promised to do so. There is a marked resemblance between benzothiazole, methyl benzothiazole, quinolin and quinaldin, as can be seen from the formulæ, and it should be possible to obtain from these two a series of dyes resembling the cyanins.

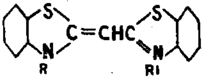
obtained two substances which were different from the thiotoluidin of the authors just mentioned, one of which was a direct cotton dye, and both of which were primary amines, from which a series of direct cotton dyes could be obtained both by diazotization and coupling, and by substitution. He named these dehydrothiotoluidin and primulin, the latter because it dyed cotton directly a primrose (primula) yellow, and prepared a number of derivatives, the methylated and ethylated bases, sulphonic acids, and several azo dyes, developed a process for producing the azo colour



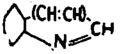
Benzothiazole



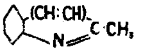
Methylbenzothiazole



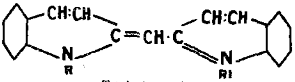
Typical thiazole cyanin



Quinolin



Quinaldin



Typical cyanin

In the cyanines the methyliodide addition products are used, and he had already noted that the methenyl base did add methyl iodide, as well as amyl iodide. In a preliminary experiment he condensed the two thiazoles, and each with the other quinolin and did obtain reactions with the formation of dyes, but he did not isolate them nor proceed further, nor does it appear that any further work has been done on these compounds.

All of this work, however, had had very little influence on commercial chemistry. Organic sulphur compounds were being manufactured and used as dyes by the Germans, but they were of the phenyl sulphide type described and prepared earlier by Merz and Weith. In February of 1888, A. G. Green,[21] chemist for Brook, Simpson, and Spiller, an English dye concern, found that by fusing paratoluidin and sulphur he

directly on the fibre using primulin, and noted that the diazonium compound of the latter was affected by light[22] to such an extent that it would only couple with the developer satisfactorily under certain carefully regulated conditions. Unfortunately, he neglected to patent his work, and as soon as his firm produced them, and the Germans became interested, they found this out, and of course, did not make this mistake. Dahl and Company immediately patented a process practically identical with Green's (D.R.P. 35790) and all of the important work which followed was covered by German patents.

P. Jacobson[23] took up this topic the following year, and after a brief review of the patent literature, and of the earlier work of Merz and Weith, Krafft, and Truhlar,[24] he

21. Green, *Jour. Soc. Chem. Ind.*, 7, 179, (1888).
Green, *Chem. Zeit.*, 1889 (484).

22. Green, Cross, and Bevan, *D. R. P.*, 56,606.
Friedländer, *Fort, d. Th.* 2, 559.

23. Jacobson, *Berichte*, 22, 330 (1889).

24. Truhlar, *Berichte*, 20, 664 (1887).

developed a better synthesis of dehydrothiotoluidin and primulin from the same starting materials, using a hydrochloric acid ex traction, and subsequent crystallization from alcohol as his method of purification. He described dehydrothiotoluidin as crystallizing in colourless needles, M.P. 190°-191°, and also prepared the phenol, colourless needles from alcohol M.P. 256°, and the acetyl derivative of this, M.P. 132°, crystallizing from alcohol in colourless needles.

During the same year Gatterman[25] investigated the reaction, and showed that dehydrothiotoluidin was different from the thiotoluidin of Merz and Weith, although Dahl and Company's original patent described it as such, but his work was not at all enlightening from a structural standpoint. He did make two important contributions, however—he noted that dehydrothiotoluidin formed a dibrom addition product in glacial acetic solution, although he did not isolate the product, and suggested naphthalene as a solvent from which primulin could be crystallized for purification. He also investigated the action of sulphur on the other toluidins.

25. Gatterman, *Berichte*, 22, 422 (1889).

(To be continued.)

TUNGSTEN.

Working of tungsten (problems surrounding the manufacture of pure tungsten were solved to a great extent before the war, but great advances have been made since that date. Casting not possible owing to the high melting point of tungsten; process of working powder into solid metal bars; rolling and cutting the rods into discs; welding discs and rivets.) W. E. John.—Journal, South African Institution of Engineers, Johannesburg, Vol. 20, February, 1922, pp. 121-9, 3s. 6d.—*(Bulletin of the Institution of Mining Metallurgy)*.

NEW GERMAN BRIQUETTE PROCESS.

A German technical journal records a new process for making hard coal briquettes without the addition of foreign binding material by heating the fine coal to the temperature at which the appearance of the slow combustion gases begins.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MAY 25, 1922, SIR CHARLES SHERRINGTON, PRESIDENT, IN THE CHAIR.

The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

PROF. C. H. LEES, D.Sc., F.R.S. The Thermal Stresses in Solid and in Hollow Circular Cylinders Concentrically Heated.

The thermal stresses in circular cylinders concentrically heated are calculated by the methods used in a previous communication dealing with spheres. It is shown that the results admit of simple graphical constructions being used for their determination. Two cases of practical importance are worked out—first that of a furnace with the temperature throughout the wall steady; second that of a pillar supporting the floor above a room in which a fire occurs. Curves are given for the thermal stresses produced in each case.

B. F. J. SCHONLAND. On the Scattering of β-Particles. Communicated by Sir Ernest Rutherford, F.R.S.

N. K. ADAM. The Properties and Molecular Structure of Thin Films. Part II.—Condensed Films. Part III.—Expanded Films. Communicated by W. B. Hardy, Sec. R.S.

Studies on films one molecule thick, on water and dilute aqueous solutions, have been extended to many saturated and unsaturated fatty acids of the long straight chain series, and to derivatives, including esters, substituted ureas, an alcohol, amide and nitrite.

In films of every substance studied, below a certain temperature determined by the conditions, the molecules appeared to be closely packed or "condensed." Above this temperature greater areas on the surface were occupied, such films being desig-d "expanded films."

vo general types of condensed film were d: one in which the hydrocarbon is are close packed, while in the other ably only the polar groups (of slightly :er cross-section) touch. Values are ced for the cross-section of a saturated

chain of $-CH_2-$ groups, and for the polar groups $-CH_2 . CH_2 . COOH$, $-CH = CH \sim COOH$, $-NH \cdot CO \cdot NH_2$, $-CH_2OH$, $-CH_2CN$, $-COOC_2H_5$.

In the temperature interval (about 25° C.) between fully condensed and fully expanded states, pressure-area curves resemble isothermals of a vapour near critical temperature. Probably expanded films resemble vapours in two dimensions. Increase in length of hydrocarbon chains raises temperature of expansion ("vaporisation") regularly. The lateral attraction which tends to keep the molecules close packed therefore depends on length of these chains. There is also evidence that the greater attraction between longer chains diminishes the area of expanded films, just as the 'a/v^2' correction of Van der Waals diminishes the volume of a vapour.

The area actually filled by molecules both of saturated and unsaturated acids is probably nearly the same in expanded and in condensed films; therefore it is unlikely that the unsaturated linkage in oleic acid approaches the water closely, as previously thought probable.

Ernest Wilson. On the Susceptibility of Feebly Magnetic Bodies as Affected by Compression. Communicated by Prof. J. W. Nicholson, F.R.S.

This communication undertakes an investigation of the complex problem which is presented by the effects of mechanical stress upon the susceptibility, retentivity, and other properties of magnetic substances. The present experiments are confined to compressive stress and its effects upon the susceptibility of what may be termed feebly magnetic substances, *e.g.*, rock specimens. It was felt that an investigation into this part of the subject might possibly throw some light upon the susceptibility of the earth's crust, as affected by the enormous mechanical forces with which it has to contend, and their variations.

It is unfortunate that owing to the nature of rock specimens, the compressive stress has been limited to about 1,200 kgm. per sq. cm., but, nevertheless, some interesting results have been obtained, and these are recorded in the present paper. In addition to rock specimens, certain alloys which may also be described as feebly magnetic, have been tested in order that a contrast may be drawn between rock specimens and metals.

All the specimens are in the form of short bars about 4 cm. in length, whose cross-section is either square, being 1 cm. across each side, or 1 cm. in diameter; and throughout the work the compressive stress has been applied in the direction coinciding with the length of the bar. The susceptibility has been measured (a) in the direction of the stress, and (b) at right-angles thereto.

S. F. Grace. Free Motion of a Sphere in a Rotating Liquid Parallel to the Axis of Rotation. Communicated by Mr. G. I. Taylor, F.R.S.

The motion is a small disturbance from one of uniform rotation, like a rigid body due to a projection, parallel to the axis of rotation, of a sphere of density equal to that of the liquid and originally at rest relative to it. The method of discussion leads to a perfectly definite mathematical problem, the solution of which has been obtained. The path of the centre of the sphere is a straight line, and the motion is symmetrical about it. The sphere oscillates about a point with amplitudes which diminish rapidly; after one revolution of the liquid the velocity of the sphere is less than 0.02 of its velocity of projection. The velocity of the liquid in this line is oscillatory, the period tending to coincide with that of the sphere's oscillation. The tangential component of velocity at any point on the surface of the sphere tends to become constant in magnitude, but the direction changes. The disturbance over the plane through the centre of the sphere perpendicular to the axis is oscillatory, and confined to the immediate neighbourhood of the sphere. The components of verticity, however, contain terms proportional to the time, so that the assumptions of small motion are ultimately violated and a physical restriction introduced.

Thursday, June 1, 1922, at 4.30 p.m.

The Croonian Lecture was delivered by Prof. T. H. Morgan, on "The Mechanism of Heredity."

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next meeting of the Society will be held on Wednesday, June 7th, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following papers will be read:—

"The Action of Natural Waters on Lead," John C. Thresh, M.D., D.Sc., F.I.C.

"The Estimation of Meconic Acid in Opium," H. E. Annett, D.Sc., F.I.C., and M. N. Bose, M.A.

"The Composition of Cows' Milk in the Sudan," A. F. Joseph, D.Sc., F.I.C., and F. J. Martin, M.A., A.I.C.

"The Use of the Daylight Limp in Volumetric and Colorimetric Analysis," W. Singleton.

THE SOCIETY OF GLASS TECHNOLOGY.

List of Officers for 1922-23.

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Past Presidents, W. F. J. Wood, C.B.E., B.Sc., F.I.C., S. N. Jenkinson, M.B.E., M. W. Travers, D.Sc., F.I.C., F.Inst.P., F.R.S.

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Editor, Prof. W. E. S. Turner, D.Sc., M.Sc., F.Inst.P.

Auditors, Edward Meigh, M.B.E., M.Sc., Dennis Wood, F.S.A.A.

THE CHEMICAL SOCIETY.

Lecture.

At the Ordinary Scientific Meeting, to be held on Thursday, June 8th, 1922, at 8 p.m., in the Lecture Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, Dr. H. H. Dale, C.B.E., F.R.S., will deliver his Lecture entitled: "Chemical and Physiological Properties."

THE OPTICAL SOCIETY.

The next meeting of the Society will be held at the Imperial College of Science and Technology, South Kensington, at 7.30 p.m., on Thursday, 8th June, 1922. The following papers will be presented and discussed:—

"Angle comparators of high precision for the goniometry of prisms," by J. Guild, A.R.C.Sc., F.R.A.S., F.Inst.P.

"The changes in aberrations when the object and stop are moved," by T. Smith, F.A., F.Inst.P.

"The classification of optical instruments," by T. Smith, M.A., F.Inst.P.

"Note on achromatism with one glass," by T. Smith, M.A., F.Inst.P., and L. M. Gillman, B.Sc.

"An improved subjective test for astigmatism," by H. S. Ryland.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Council of the Institution of Electrical Engineers have made the following award of premiums for papers read during the session 1921-22, or accepted for publication:—

The Institution Premium, to Mr. J. G. Hill.

Ayrton Premism, to Mr. L. H. A. Carr.

Duddell Premium, to Mr. T. L. Eckersley.

Fahie Premium, to Mr. E. S. Byng.

John Hopkinson Premium, to Mr. F. P. Whitaker.

Kelvin Premium, to Mr. R. Torikai.

Paris Premium, to Mr. J. A. Kuyser.

Extra Premiums, to Mr. J. Anderson, Mr. F. J. Teago, Mr. W. Wilson.

Wireless Premiums, to Mr. E. B. Moullin, Mr. L. B. Turner, and Mr. C. S. Franklin.

Willans' Premium (awarded triennially alternately by the Institution and the Institution of Mechanical Engineers), to Mr. K. Baumann.

GEOLOGICAL SOCIETY OF LONDON.

On May 12th, the President, Prof. A. C. Steward, D.Sc., F.R.S., delivered a lecture entitled "Geological Notes on Western Greenland," of which the following is a brief summary:—

Greenland is a "closed" country; the trade is a monopoly of the Danish Government, and no foreigners or Danes other than Government officials are allowed to go there without special permission. On June 18th, 1921, the lecturer left Copenhagen, accompanied by Mr. R. E. Holttum, of St. John's College, with the primary object of collecting fossil and recent plants on Disco Island and at other localities between lat. 69° N. and 71° N. Godthaab was reached on June 28th, and Godhavn (Disco Island) on July 4th. Rather more than three weeks were passed at the Arctic Station at Godhavn with Mr. Porsild, the Director, who rendered invaluable service. The Arctic Station, which was planned and directed by Mr. Porsild, was afterwards taken over and subsidised by the Danish Government. In the course of two motor-boat excursions a distance of over 600 miles was covered; many localities were visited on the northern and north-eastern coasts of Disco Island, on the coast of Nugsuak Peninsula, also Hare Island, Upernivik Island, Ritenbenk, Sarkak, and Jakobshavn.

Greenland is an island nearly 1,700 miles long, with an average breadth of about 600 miles; approximately a hundred glaciers from the inland ice reach the sea, the largest of which (the Humboldt Glacier) ends in a cliff 60 miles broad. In the course of the lecture attention was called to the various forms of icebergs seen in Greenland waters, and to the views expressed by Mercanton on the origin of the various types. A brief account was given of some of the characteristic types of vegetation. A general account of the physical and geological features of Greenland as a whole was followed by a more detailed description of the Cretaceous and Tertiary sedimentary series of Disco Island and the Nugsuak Peninsula, and of the overlying and protecting basalts which in some places rest directly upon the old Archæan land-surface, to the exclusion of the sedimentary series. Special attention was directed to the nature of the sedimentary rocks (most of which are freshwater in origin), to the occurrence of raised beaches, to evidence of recent sinking of parts of the striking examples of dykes and sills in the Cretaceous and Tertiary sedimentary series.

No attempt was made to describe the palæobotanical results; but allusion was made to some of the problems presented by the Cretaceous and Tertiary floras.

The next meeting of the Society will be held on Wednesday, June 14th, 1922, at 5.30 p.m., when the following communications will be read:—

1. "The Petrography of the Cretaceous and Tertiary Outliers of the West of England," by Prof. P. G. H. Boswell, O.B.E., D.Sc., D.I.C., F.G.S.

2. "On some Rugose Corals from the Burindi Series (Lower Carboniferous) of New South Wales," by Prof. W. N. Benson, B.A., D.Sc., F.G.S., and Dr. Stanley Smith, M.A., F.G.S.

THE INSTITUTION OF MINING ENGINEERS.

PRELIMINARY NOTICE OF GENERAL MEETING, AT SHEFFIELD, ON JUNE 20TH, 21ST, AND 22ND, 1922.

The Seventy-seventh General Meeting of the Institution of Mining Engineers will be held at Sheffield, by invitation of the President and Council of the Midland Institute of Mining, Civil, and Mechanical Engineers, on Tuesday, Wednesday, and Thursday, June 20th, 21st, and 22nd, 1922, at the Cutlers' Hall, by kind permission of the Master Cutler.

INDIA.—JOURNAL OF THE INSTITUTE OF ENGINEERS.

His Majesty's Senior Trade Commissioner in India has sent to the Department of Overseas Trade copies of the first two volumes of the Journal of the Institute of Engineers (India), which have been furnished to him by the Secretary. These volumes show the rapid growth of the new Indian Institution, which has been entrusted with questions affecting the standardisation of materials in India in conjunction with the British Engineering Standards Association in London. The volumes contain papers contributed by engineers in India, on such subjects as the Howrah Bridge, Light Railways in India, Hydro-electric Power, the Manufacture of Portland Cement in India, Water Supply of Bengal Towns, and Electro-chemical Industries, and may be inspected by interested persons on application to the Department (Room 50 A), by quoting the offi-

GENERAL NOTES.

BRITISH TRADE SHIP.

In view of recent announcements of a projected voyage round the world by the steamship "Orontes," renamed "British Trade," confusion has arisen between this voyage and that arranged for another vessel under the auspices of British Trade Ship, Limited, of which Earl Grey is chairman.

The "Orontes," or "British Trade," has no connection whatever with British Trade Ship, Limited, whose proposal is to build a special ship for the purpose of an exhibition and send her round the world in 1924.

The intended voyage of the "Orontes" follows very closely the itinerary sketched out for the British Trade Ship, but Earl Grey and his co-directors of British Trade Ship, Limited, desire to make it quite clear to intending exhibitors on the "Orontes" (or "British Trade") that British Trade Ship, Limited, is in no way responsible for any arrangements in connection with the "Orontes'" voyage.

DANGEROUS DRUGS LICENCES.

In the House of Commons last week, Sir J. Baird, Under-Secretary to the Home Office, informed Mr. Hinds that licences under the Dangerous Drugs Act had not been issued to agriculturists, but under an Order of last August, farmers and stock-owners in certain circumstances could obtain a certificate from the Chief Officer of Police which enabled them to obtain tincture of opium for use in the treatment of animals. No fee was chargeable for the certificate.

KEEPING OF POISONS.

Mr. Shortt, the Home Secretary, in reply to Major Barnett, said that he was advised that the regulations for the keeping of poisons directed them to be "kept in a room or cupboard set apart" for the purpose, and that the observance of this rule should in ordinary circumstances render such occurrences as deaths from strychnine poisoning by misadventure impossible. Enquiries were being made of the Pharmaceutical Society as to the practicability of employing definite and distinctive colours for poisons, and if a favourable report was received, the possibility of making new regulations under the Poisons and Pharmacy Acts would be considered.

BRASS CASTING RESEARCH.

The British Non-Ferrous Metals Research Association, 71, Temple Row, Birmingham, has carried out an extensive research on the influence of gases on high-grade brass. A further investigation is now being started by the Association at the Research Department, Woolwich, in which the support of the Engineering Co-ordinating Board of the Department of Scientific and Industrial Research has been secured.

The advance which has been made in the quality of materials as a result of the increasing demands of the engineer, is not always easy to appreciate, even by those most closely connected with the industry. Well defined specifications and the provision of a greater variety of tests have certainly assisted in these inprovements. Brass, both in its cast and worked forms, has shared in full measure in this progress, but the demand is ever for further improvements.

The prime object of the present work is to study the conditions necessary for securing both surface and internal soundness of strip brass ingots, such as are required for cold rolled sheet metal. The investigation will throw much light on other types of casting in non-ferrous alloys, and should interest a wide circle of manufacturers in the metal and engineering trades. Dr. Harold Moore, O.B.E., and Mr. B. Genders, B.Met., who have already been engaged successfully on similar work, will have charge of the research, which will be conducted partly in the works of members of the Association and partly in the Woolwich Laboratories.

NOTES ON BOOKS.

Colloid Chemistry of the Proteins, by PROF. DR. WOLFGANG PAULI, translated by P. C. L. THORNE, M.A. (Cantab.), A.I.C. Part I., pp. XI. + 140. London: J. & A. Churchill, 1922. Price 8s. 6d.

Difficultly soluble substances like the metallic sulphides and those bodies of high molecular weight, such as the proteins, lend themselves most readily for transformation into the colloidal condition. Indeed, it is not uncommon for proteins to occur exclusively in this state.

The application of the quantitative methods of physical chemistry to the study of the proteins has been most fruitful, and has enabled Dr. Pauli to advance a consistent theory of the behaviour of these very complex and elusive substances.

This volume includes much recent work and also the results of the author's researches which have not appeared previously. The salts of albumin and of globulin with acids and with alkalis are considered very fully, and special mention must be made of the chapter dealing with the various methods for determining the mobility of protein ions.

Dr. Pauli's original volume was based upon his lecture notes, and this translation should be well received by the English-speaking scientific public. J. G. F. D.

The Analysis of Fuel, Gas, Water and Lubricants, by S. W. PARR. Third Edition. Pp. XII. + 250. New York: McGraw-Hill Book Co., Inc. (London: 6 & 8, Bouverie St., E.C.4), 1922. Price 12s. 6d.

It is frequently difficult to arrange a useful course in Chemistry for Engineering students, which will enable them, later on, to read intelligently and with advantage the applied chemical literature of their main subject.

The present edition of Prof. Parr's valuable book on the analysis of products of importance to engineers has been expanded to admit of its being used by students of chemical, as well as those of mechanical engineering.

Matters of local (Illinois) interest, *e.g.*, fuel supplies, have naturally received especial mention. American methods and original work are referred to more frequently than are the European, but it is surprising to note that Mabery's name is wrongly spelt on p. 137.

Part I. is based upon the author's lectures and describes the analysis of various fuels, due attention being given to sampling, storage and deterioration; the examination of boiler waters is also described. This subject could be taken early in a course, since it involves a revision of much elementary chemistry. The important but brief chapter devoted to lubricants might be expanded with advantage.

Part II. deals with the details of the laboratory methods, particularly Calorimetry and Gas Analysis (modified Orsat's method). The examination of boiler waters and of oils also receives adequate treatment for such a course.

The book will doubtless appeal to lecturers on this section of applied chemistry, and the fact that it has already reached its third edition indicates that it meets a real need. J. G. F. D.

The Popular Chemical Dictionary, by C. T. KINGZETT, F.I.C., F.C.S. Second Edition. Balliere, Tyndall & Cox, 8, Henrietta St., Covent Garden. Price 21s. net.

The second edition of this well-known book has been enlarged so as to keep pace with the rapidly growing developments in chemistry, and attention has been given to the study of colloids, nitrogen fixation, the flotation processes of ore dressing, radio-activity, refractories, &c.

The author's object has been to produce an encyclopædia of information for the use of professional chemists, merchants, and all who have to deal with chemical manufactured or natural products, and to give in simple language a comprehensive description of each material or subject included. In some cases, as under the heading of colloid, the description runs into several pages and forms a very complete though condensed resumé of the subject. Numerous illustrations are included, as well as a good deal of tabular matter. Some of the illustrations appear to be of rather a rough character, and in some cases unnecessary. For instance, under the heading of Dessicator there is given a picture of a Tait's air pump, which seems rather out of place.

At the end of the book there is a glossary of words used in chemical science under the heading of Addenda, which is a very useful feature of the book.

Practical Plant Biology, a course of Elementary Lectures on the General Morphology and Physiology of Plants, by HENRY H. DIXON, Sc.D., F.R.S., with 94 illustrations. Longmans, Green and Co., London, 1922. Price 6s.

The book consists of a series of 30 lectures designed as an introductory course in Botany for medical and other science students. Special attention is given in the first lecture to the use and manipulation of the microscope as an aid to biological study, and some very good half-tone photomicrographs are produced.

Each of the following 29 lectures is devoted to a special biological study. Each lecture is followed by a brief course of practical work on the subject of the lecture, thus making the book extremely valuable for individual home study. Biological students generally will welcome the publication of this important series of lectures by a master of such standing as Professor Dixon. We are glad to find that the book ends with a very complete index.

The Principles of the Phase Theory, by DOUGLAS A. CLIBBENS, PH.D. Pp. XX. + 383. London: Macmillan & Co., Ltd., 1920. Price 25s.

Dr. Clibbens has dedicated his book to Prof. Schreinemakers, and it is interesting to note that the physical chemists of Holland have been conspicuously productive of important results in the particular branch of chemical science dealt with in this volume on the Phase Theory.

A study of its principles has enabled us to understand the conditions of equilibrium of binary and other systems under varying conditions of temperature and concentration. The theory has been fullf studied for salts and aqueous solutions in condensed binary and ternary systems, etc.

The graphic mode of representation has been considerably developed in this connection, and it may be emphasised that *every point* on a diagram has a definite meaning. This is frequently overlooked and attention is apt to be confined to the *curves only*.

The author evidently has a thorough grasp of the principles of the phase theory and heterogeneous equilibria, and his non-mathematical treatment of the subject will be of special service for students, and for whose advantage, presumably, be sometimes repeats himself. J. G. F. D.

THE CHEMICAL, METALLURGICAL, AND MINING SOCIETY OF SOUTH AFRICA.

THE PRESIDENTIAL ADDRESS.

OCTOBER 15, 1921.

By F. WARTENWEILER, A.I.M.M.

It is not uncommon for your President, in his inaugural address, to present a review of recent progress reflecting the current position of that section of the Society's activities in which his own particular interest lies. I have therefore decided to follow, in the main, in the footsteps of this accepted principle. If, at times, I tread on controversial ground, it is for the purpose of inviting full discussion on such subjects as show the trend of recent scientific thought and experience toward radical improvements or changes. I do not altogether decry verbal pyrotechnics and sensation disclosure, as these often have the power of galvanising our members into interest and action.

Basic progress in science is notably slow and by reasoned stages. Many of us, engrossed in our routine tasks and having the responsibility of maintaining the high standard of efficiency set before us, are, perhaps, barely cognisant of the slow development of the art until we pause to consider and review. It is then that evolution is revealed. With these observations I will proceed to illustrate.

UNDERGROUND FEATURES. — In dealing with the Metallurgy of the Witwatersrand it is often taken for granted that the initial steps begin after the ore has been hoisted to the surface and delivered to the reduction department. On some mines this can be accepted as the starting point for the beneficiation of the ore. On others, however, natural chemical processes, which affect the subsequent treatment, begin in the stope, the ore pass and the pump sump, and it is due to the recognition of this fun-

damental fact that one large group has begun ore treatment underground and has extended the responsibility and usefulness of the chemist and metallurgist. I allude to the chemical control of neutralisation of acid mine water by means of lime, the settlement of sludge, its subsequent disposal, and the maintenance of a favourable composition of water for re-use in dust allaying, in which there are pitfalls unseen except by the trained chemist. The precipitation, from a supersaturated mine water, of the calcium sulphate formed in neutralising or its prevention by adequate dilution, cannot be ignored without the payment of the penalty, scale in pipes, or the purchase of an expensive precipitant.

The precise chemical control appeals to the economist and mine owner as a means of saving tons of steel and other corrosive material used underground, not to mention that of cyanide at the surface plant. As an example the experience of one mine may be mentioned where, by careful control, cyanide consumption has been lowered from 0.28 lb. to 0.18 lb. per ton ore treated.

Acidity in mine water has been known to be sufficiently high in some old workings to blister the flesh of men coming in contact with it, as the episode of a mine manager who had such a practical though painful demonstration. We have also heard of miners who have suffered from the burn of strong alkalinity by coming in contact with an accumulation of milk of lime in some back water underground. The one points to the moral of the usefulness of information on the degree of acidity, the other, of wastefulness of lime when not applied under precise control or at the most effective place.

The practice of underground support by means of ore packs is well known, and has been described at our meetings by several members in an interesting manner. In view of the chemical and physical alterations taking place in these packs the question arises whether such a method of mining affects the subsequent extraction of gold, and to what extent. No satisfying answer has been forthcoming, perhaps due to lack of opportunity for a definite test.

Sand filling, which has returned hundreds of thousands of tons of residue sand to the place of origin, the stope, has found its way back to the reduction plants in small quantities, particularly on outcrop mines, where ground movements and consequent break away of sand barricades take place. The incidence of this acid material in the extraction of gold from the clean current ore is noted by reduction men to be adverse.

Crushing and Sorting, operations so closely related, locally, as to be dealt with under one heading, is such an important and comprehensive subject that it could easily form the sole basis of a paper. Interest seems to have lagged of late years. Is it because the existing plants are considered capable of fulfilling all requirements from the point of view of efficient crushing, sorting, and low cost of operation? Not until you make a close study of various types of stations now in operation are you impressed with the variety of objectives originally affecting the design of each.

The early designers, in the pre-conveyor belt days, built skywards and in conjunction with rotary sorting tables, often employed crushers at the highest point of the structure for cracking large rock prior to sorting. Many of these old plants continue in operation, and excellent work can be obtained. Sorting to the extent of 16 per cent. has been carried out in a station of this type by picking out the valueless class of reef in addition to the usual quartzite and dyke waste.

We then come to the type of station employing conveyor belts, and in which sorting and crushing in two stages is practised. Although the high sorting percentage possible with such a design has fulfilled the most sanguine expectations in this direction, lack of native labour and the economic factors have usually retired it in favour of the simple straight line design now found on our later plants. Such a station with trommel washing or with washing on a sharply inclined portion of the sorting belt lends itself, by reason of simplicity, to minimum capital and running expenditure.

One of the latest plants provides for the washing of all the ore coming from the mine, including the grizzley by-pass, called unsortable fines, which comprise as high a proportion of the ore milled as 40 per cent. This is an innovation and the object is three-fold; first, the avoidance of sending slushy fines to the stamp mill bins, the moisture from which leads to decay of timber and battery foundations, rusts steel, and indirectly causes stem and cam shaft breakage through irregular feed; second, all material passing a ½-inch punched screen is sent to its most efficient grinding

machine, the tube mill; third, the chemical motive, which allows thorough neutralisation with lime water of that portion of the mine delivery which benefits by such treatment. It is of interest to note that as much as 15 per cent. of the ore milled is by-passed by this method.

With the realisation of the expense of conveyor belt wear and tear, the readoption of preliminary cracking of large rock is being considered in order to reduce incidental rough usage. Also washing trommels stationed at the primary bins are favoured for the elimination of the slushy fines, so that no belt need become a conveyor of a material which, having the property of mobility, is preferably transported by the impulse of a modern centrifugal pump. The sorting percentage becomes a function of the number of native sorters and the amount of waste present. This last depending so often on underground conditions and the reef formation. It is, perhaps, not always realised that many mines, owing to peculiarities in their payable ore channel, present individual problems in sorting which must be studied separately if this important part of ore dressing is to be conducted on an intelligent and scientific basis.

Regarding crushers, which are taken so much for granted, the two standard types, jaw and gyratory, continue to hold the field. That stamping efficiency is greatly advanced by careful maintenance of their wearing parts and by close setting has always been known, and has again reached the practical stage since manganese steel need no longer be devoted solely to armament purposes.

STAMPING.—The Californian stamp and its first cousin, the Nissen, have survived. There are those in our Society who hold the view that these will continue to crush Witwatersrand banket ore at least during our generation. Others feel that improved modern ball or tube mill development will seal their doom as an economical stage crusher. The question is extensive in its bearings, and is most important. Working experiments have recently been conducted on this very point at one of the far East mines. To what extent the crusher and the tube mill can economically encroach on the domain of the stamps, squeezing it out of existence, between their extended functions, is a point for careful trial on an extended working scale. Let us offer the columns of our *Journal*, as in the past, for the discussion of developments on this subject.

It is on this mining field that the heavy gravity stamp has reached its highest state of perfection. The 1850 pound Californian stamp at the Government Areas mill crushes 28.5 tons per 24 hours through a screen aperature 0.625 of an inch square, while at New Modderfontein the 1,900 pound Nissen stamps 31.5 tons through a somewhat finer screen.

If you are statistically inclined, the size and power of the stamp mills on the Witwatersrand may be illustrated in various ways. For example: if all the 10-stamp batteries were placed adjoining they would make one continuous line extending for a distance of two and a half miles. If all the stamps were combined into one the blow of this mammoth stamp would be equivalent to a weight of 5,200 tons dropping eight inches 99 times per minute.

The roar of stamp mills since the early Californian days has followed the axe of the pioneer in many parts of the world, and whatever may be their ultimate fate, to those of us who have spent many working hours in a stamp mill, the surf-like roar of its many batteries will remain impressed in our minds as symbolical of the restlessness and untiring energy of the gold mining indutry.

TUBE MILLING.—Tube milling practice nowadays appears to be rather one of detail. The tube mills are called upon to grind to a finer degree of comminution than ever, one plant delivering a final product of which 90 per cent. passes the 90 linear mesh screen. Good practice now demands a coarse feed, the new installations feeding ½-inch maximum size. The trials referred to previously experimented with feed as coarse as that fed to stamps.

Scoop discharges of varying effective lift with screen openings of ample size to permit free discharge of the spent pebble are generally adopted except on old plants where the use of small motors does not permit the resulting high power load. Shell liners of the Osborn and El Oro type find general favour. These are keyed and require no holding bolts. End liners are

either cast or forged from discarded stamp mill shoe shanks or dies.

No recent data has been published of the merits of the short 6-ft. dia. by 16-ft. length tube in comparison with the orthodox size, 5-ft. 6-in. dia. by 22-ft. There are also a few 6-ft. dia. by 20-ft. mills in operation whose performances have yet to be compared.

Since the trials of the Giesecke ball mill, to my knowledge, no further attempts have been made with steel balls. How effective a modern large diameter ball mill would be on the banket ore leads to interesting speculation. It should be recognised, though, that this ore is one of the hardest and most abrasive known, and a steel ball which readily crushes porphyry ore may prove impotent on banket. There are undoubtedly degrees of hardness and toughness in the ore delivered to reduction plants scattered from Randfontein to Springs, and it may be no idle speculation to look forward to the discovery of an ore that will lend itself to a change in grinding medium.

AMALGAMATION.—Like taxes, the ancient amalgamation recovery method is still with us, and is responsible for from 40 to 70 per cent. of the assay value of our mill feed. While, with our system of classification, preferential amalgamation really takes place in practice, the question arises whether this could not be intensified and mechanical contrivance and concentration called in. The day of the non-amalgamating plant and the extraction of all recoverable gold by cyaniding may arrive. In fact, one mine has committed itself, and elsewhere working trials having this in view have been projected and are only awaiting opportunity and adequate support. Undoubtedly the knowledge that visible coarse gold is found in certain portions of the richer mines has acted as a deterrent with responsible officials. Aside fro many technical advantage, the introduction of a method which reduces or eliminates the risk of mercury poisoning would seem to have human merit.

CYANIDING AND CHEMICAL TREATMENT.—No fundamental changes have been effected in cyaniding in the last few years. Considerable experimentation, however, has been conducted quietly, resulting in gains here and there. The practicability of collecting sand and its treatment in the same tank is well established at one of the most recently erected plants. Careful classification is a corollary. The importance of close classification and the advantage of fine grinding of the pyritic portion of the ore is receiving constant attention by reduction officials.

Cyanide solution strengths have been on the down grade, and with the adoption of de-aeration of solutions prior to precipitation they will continue on this course. The saving of cyanide and zinc resulting from this constant pressure of experimentation with lower and lower cyanide strengths and with improved precipitation technique has been considerable. On one group of mines alone it has amounted to a quarter million sterling in five years.

Precipitation has received due attention, and on some of the plants a feed rate per diem of 2.3 tons of slime solution per cubic foot of zinc shaving in extractor boxes is current practice. The Chamber of Mines financed extensive trials on the de-aeration of cyanide solution, and, resulting from these, mechanical de-aeration has been decided on at five reduction works, of which three installations are in operation. The expectation of direct and indirect economy promises to be fulfilled. Interesting details, it is hoped, will be brought forward for discussion this year.

Precipitation research has not been lacking within recent years; the margin of possible improvement, however, is small, and any new process calling for a new installation with heavy capital expenditure is severely handicapped by economic considerations.

Oxidising reagents by reason of rapidity of reaction and expense do not find favour these days. Their effect is evanescent and apt to be harmful. The economical and satisfactory supply of oxygen continues to be derived from free air. Experience with de-aeration has taught us how readily air dissolves in solution and how watchful one must be to prevent this at certain stages of the cyanide process.

Vacuum filters are now accepted by the majority as standard slime washing equipment for new plants. Their washing is controllable, depending so much less than the decantation process on ratio of dilution and on the weather. Many installations maintain a consistent daily capacity rate of 3.5 tons dry slime per leaf.

(To be continued.)

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

13466—Cateret, G.—Process of producing oxygen compounds of titanium. May 12.

13057—Ercole, A.—Process for manufacture of fertilizers. May 9.

13567—Hechenbleikner, L. Treatment of acids. May 13.

Specifications Published this Week.

154,231—Slatineau, E.—Process and apparatus for obtaining reactions between a gas and another substance.

179,031—Thron, Dr. R.—Process for the manufacture of O-alkyl derivatives of hydrocupreine.

161,539—Farbwerke vorm.—Manufacture of a-dialkly-aminoethyl B-aracyl oxybutyric esters.

179,096—Fairweather, H. G.—Method of producing hydrocyanic acid.

Abstract Published this Week.

Synthetic Drugs.—Patent No. 177,283.—Mr. J. Anderson, of Messrs. Boots Pure Drug Co., Ltd., Station St., Nottingham, has obtained a Patent for some new methods of obtaining Synthetic drugs, particularly 3 3′ Diamino-4; 4′ dioxyarsenobenzene compounds. A neutral soluble compound of 3.3′ diamino-4 4′ dioxyarsenobenzene base and glucose is prepared by dissolving the base in alkali, adding glucose and well mixing, and finally neutralising with hydrochloric acid. The resulting solution may be employed as such for therapeutic use, or the compound may be isolated by precipitation by alcohol, acetone, etc. The product may also be prepared by warming a suspension of the base in glucose solution, or according to the Provisional Specification, by dissolving the base in hydrochloric acid, mixing with glucose, and then neutralising with caustic soda.

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WANTED, Nature Nos. 2536 (June 6, 1918), Nature Nos. 2580 (April 10, 1919), Nature Nos. 2594 (July 17, 1919).—Reply, stating price, to "A.S.," Messrs. Puckey & Co., 153, Fleet Street, London. E.C.4.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3244.

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THE CHEMICAL, METALLURGICAL, AND MINING SOCIETY OF SOUTH AFRICA.

THE PRESIDENTIAL ADDRESS.

OCTOBER 15, 1921.

BY F. WARTENWEILER, A.I.M.M.

(Continued from Last Week.)

SMELTING AND REFINING. — No innovations have been introduced in recent years into refining and smelting on the individual mines. The large Refinery erected near Germiston by the Chamber of Mines for the purpose of refining the gold output of the Witwatersrand by the chlorine process is about to operate, and will no doubt offer a most interesting study to our technical men. We hope to be favoured with a description of its technology in due course.

Acid treatment of the gold-zinc slime from precipitation remains general practice, although with the precipitation improvements referred to this will possibly be discontinued. Subsequent calcination and pot smelting or reverberatory lead smelting is the practice according to preference or works convenience. Small blast furnaces are found useful for smelting by-products on the larger mines. For others the Witwatersrand Co-operative Smelter, a most excellent institution, fills all requirements. The treatment by cyanide of the "black sand" or pyritic by-products from amalgamation has received attention by many of our members, and is well established.

Periodically, schemes for utilising the zinc sulphate liquor, now wasted, are brought forward. Many of them are ingenious and have undoubted merit, and I confidently look forward to an economic utilisation of this liquor.

In concluding the foregoing traverse of local metallurgy, I venture to reiterate that

sound development is visible, and in the words of the young assayer who found a large-looking speck of gold unweighable, is at least equivalent to "two traces."

BASE METALS.—During the present slump in the sale value of base metals these have been neglected in the presence of their gigantic gold neighbour. Our Society has always been interested in the metallurgy of the baser metals, and we have had interesting papers in the past, and look forward to others in the future. Not many miles from here a silver lead smelter was blown in only the other day, that of the Transvaal Silver and Base Metals Co., at Argent. Tin has been smelted for several years at the tin mines situated up-country, and that fascinating branch of metallurgy, that of copper, has been practised at Messina and the Falcon Mine with great activity throughout the war. Great developments are from all accounts taking place at the Congo copper mines in that remote and therefore mysterious region. Rhodesia boasts of a large working chrome iron deposit. Pyrite is being mined in the Lydenburg district, and, after concentration, is sold to chemical plants for both its sulphur and gold content. Considerable asbestos and mica are mined in South Africa, yet the method of selection and preparation for the foreign market, or in other words, the ore dressing, remains a sealed book to most of us.

INDUSTRIAL CHEMISTRY.—During the latter part of the Great War, South African chemical industry received an impetus. Many chemicals were not importable and must of necessity be produced in the country. Artificial chemical fertiliser was among these. Bones suddenly loomed important in the economy of food production as potential carriers of the essential plant foods, phosphate and lime. Kraal ash deposits in the dry Karroo region were sought after for their comparatively low potash content, and bat caves and mineral phosphate deposits were prospected for with the hope of filling the gap in the supply of the necessary phosphates and nitrates. The production of fertiliser is of national importance, particularly applicable to the older districts where the chemical food capital of the soil must not be withdrawn without due replacement. The war-devastated Somme region in Northern France, in appearance not unlike a sweep of the high veld, will again bring forth its wonderful cereal crops, being underlain at grass roots with calcium phosphate. The very mine craters and shell holes have scattered their phosphatic contents over the surrounding soil, replacing that taken away in the form of food.

Some of the fertiliser factories of the Union have survived foreign competition, particularly where low cost raw supplies are available. For the manufacture of superphosphate, phosphate continues to be imported, no lime phosphate having as yet been discovered. Has the Government pushed any reconnaissance or survey in this respect? Has it found it hopeless, and must our wheat production of the future lie at the mercy of imported phosphate? Has the arid coast of the mandated South-West been closely prospected for the life-giving mineral tricalcic phosphate?

In another field of industrial chemistry, between Pretoria and Warmbaths, is situated a truly interesting deposit of carbonate of soda. It is more aptly termed a source, since the soda liquor seeps into boreholes like water into a well. A chemical industry has been developed there, employing crystallisation processes which follow modern lines and are well worthy of study.

Coal of the bituminous class, with which South Africa is plentifully blessed and which is engaging the attention of our captains of industry, is the most wonderful raw chemical substance produced by nature. It can maintain life and civilisation, and, by the known combination of some of its elements into modern explosives and poison gas, can also deprive us of these and force mankind back to barbarism.

At near-by Witbank, an experimental plant on a working scale has been in commission for a short time on waste coal, and is producing a few of the many by-products which start the ball rolling on endless organic subdivisions. The first produced are coke, road tar and creosote, the beginning of an industry of the first importance which, if developed in all its creative ramifications, can render the country, and thereby its people, inestimable service.

The ceramic industry of this district, dealing with the modest art of clay utilisation, is one of magnitude, and produces materials for our furnaces of a quality second to none in the world.

RESEARCH.—Our Society has been noted for the presentation of original papers describing the results of successful construc-

tive researches in pure science. How often negative answers are the reward of long, patient searching in laboratory and works many are too well aware. Such work, although valuable at times in a negative sense, is quietly buried in files.

Research is a tender plant and requires a congenial atmosphere. Inspiration and concentration are its companions. Surroundings, nature of colleagues, past successes, praise, sometimes condemnation, are also forces which circulate its life blood. Research is said to be the occupation of a gentleman. It is a noble calling and should, in theory, be unhampered by financial considerations. The scientist so engaged must have imagination, originality in addition to knowledge, and his mind should be free from all outside worries in order to be receptive of the smallest sign leading to actual discovery. These often hinge on the veriest trifle or on accident. However, if Goodyear, the inventor of rubber vulcanising, had not been engaged in rubber research for years, he would in all probability not have observed the peculiar effect of the heat on a mixture of rubber and sulphur, fallen by accident, on his stove and thus producing the first vulcanised rnbber.

Research is often far-reaching in its indirect effect. A member of our Council made public at one of our meetings, as a result of careful research, a short method of determination of oxygen in cyanide solution. This method has supplied a means of obtaining information about our cyanide plant solutions which has proved both instructive and useful.

Perhaps I may be permitted to indulge in a personal reminiscence while on this subject. When engaged in the early days of cyaniding with my chief, on the economic solution of the Homestake cyanide problem, to our dismay the sand charges refused to yield more than fifty per cent. of their gold content. Not until the discovery was made that although well drained most of the extraction was taking place in the top half of the charge, was any progress made. The chief then made one of those correct deductions, characteristic of his well-trained mind, that owing to the presence of a strong oxygen absorbing constituent in the ore the bottom half of the charge suffered under a deficiency of that necessary element, and that to overcome the then prohibitive expense of double treatment oxygen might be supplied by blowing air through the sand from beneath the filter mat. This vroved to be sound and practically spelled success to the cyanide treatment of Homestake tailings. Although apparently a small point, in its result it has been of the utmost practical value.

THE HUMAN ELEMEGT.—And, gentlemen, before I close, permit me to speak briefly on the human element, a subject in which our Society has always shown interest and voiced opinions.

To my knowledge, few more elaborate ways and means for partaking in sport and recreation are offered to the employee of industrial concerns anywhere than those which are found on this mining field. With the inception of the 6-day week for reduction workers the nightmare of the 7-day working week has disappeared. As a Society we continue to promote and discuss safety first and health measures, as witnessed by the symposium on prevention of miners' phthisis.

As a class scientists and technical men are inarticulate, and although of no mean mentality and accustomed to the acceptance of responsibility, carry but little power and inject no force into public life. Perhaps studious inclination and political disinclination are at the root of it. It is certainly to our disadvantage in these days when brazen throats and the reiteration of fallacious shibboleths by phrasemongers sway and govern the world. Perhaps we prefer not to mix in the poison gas of public affairs. However that may be, let us hope that our abstinence will never lead to the extinction of what we call our civilisation. It is held by thoughtful men that we have a public duty to perform and a responsibility to accept. As men trained in natural science and disciplined in the hard school of facts, we are expected to possess that conception of duty and love of truth which leads to high ideals. And one of these may well be the stimulation of greater intellectual and creative interest in the every-day life of those performing the routine work of the industries and processes which we have the honour to organise and direct. Our leadership should be an inspiration to those engaged in the wide field of applied science.

We are expected by the country to blaze the trail of scientific and technical progress, not only by transplanting the knowledge and the known processes of technology to these shores, but also to create new methods and to discover fresh resources.

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By Martin Meyer, B.Sc., M.A.
New York City.

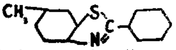
(*Continued from Last Week*).

The work of Anschütz and Schultz [26] which appeared at the same time, was vastly more important commercially for a great number of patents sprang up from the small space of this paper as a resting place. They studied the action of sulhur on a number of aromatic amines with the following results:—

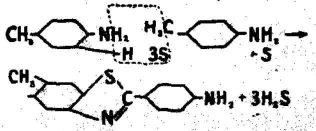
Starting Material	Product	M.P.	Solvent	Form
1. P-toluidin	Dehydrothiotoluidin $C_{14}H_{12}N_2S$	191°	EtOH	Yellow needles
acetyl derivative of	,,	225°	EtOH	Yellow prisms
2. Amido *m*-xylol	Dehydrothioxylidin $C_{16}N_{16}$ N_2S	107°	EtOH	Yellow prisms
acetyl derivative of	,,	227°	EtOH	White needles
Noted the formation of a dibrom addition product				
3. *Amido p-xylol*	Dehydrothioxylidin $C_{16}H_{16}$ N_2S	144°	EtOH	Yellow *needles*
acetyl derivative of	,,	212°		
Also forms a bromine addition product.				
4. Pseudo-Cumidin	$C_{18}H_{20}N_2S$	183°	Benzol	Small yellow crystals
	$C_{18}H_{20}N_2S$	125°	EtOH	Yellow needles

Up to this point the structure of the compounds had not been considered ,except by Green, who assigned to the dehydrothiotoluidin on very little evidence, the structure

which is not accepted at present. Gatterman and Pfitzinger[27] now took up the problem. In his previous article just cited, I had prepared



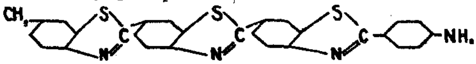
M.P. 123°, by removing the amino grou from dehydrothiotoluidin, and he no showed that it was a member of the benz thiazole group and was identical with th product previously prepared by Hess[28] from one of the aminothiocresols and ben zoyl chloride. To prove this he synthesize it from thiobenzotoluidid by the method Jacobson, and proved all three products be the same. By hydrolysis he then split the two substances and showed that they gave the expected acids and aminothio cresol. From this he concluded that dehydrothiotoluidin was formed by this reaction



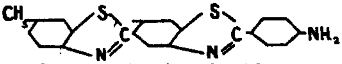
26. Anschütz & Schultz, *Berichte*, 22, 580 (1889).
Bayer & Co., *D. R. P.*, 65402; Fried-

and had the structure given.

The work on primulin was quite as satisfactory, as it led to two conclusions between which the difficulties of purifying the primulin prevented them from choosing. It may be considered to be formed from two moles of dehydrothiotoluidin similarly to the latter itself, which would give the formula



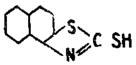
or from one mole each of dehydrothiotoluiddin and paratoluidin which would indicate it to be:



From 1885 to 1890 a great deal of work was accomplished in the thiazole field; Hantsch and Weber, [29] and Möhlar[30] and Krohn prepared the methenyl bases, the latter from methyl and dimethyl anilin and sulphur, while several syntheses of the Rosenkörper were accomplished, from benzalanilin, and benzyl anilin by Ziegler[31] and Wallach. [32] Jacobson's original work on the action of oxidizing agents in alkaline solution on the thioanilides has already been mentioned, and he published a number [33] of articles on this reaction by himself and in collaboration with Ney; as well as on the other reaction he had discovered, namely, that of carbon disulphide on oxyazo linkings to produce thiobenzothiazoles, while from 2 thiazole mercaptan by treatment with aniline, Kalkhoff, [34] and Jacobson, [35] separately, and the latter and Schenke (just given) had made phenylaminobenzothiazole.

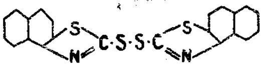
In 1891 Jacobson and Frankenbacher [36] prepared several new compounds by treating mustard oils with sulphur.

1.



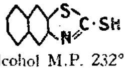
M.P. 240° small colorless crystals from alcohol.

2.



M.P. 194°, crystallizes from benzol and reacts with $HgCl_2$ in alcoholic solution.

3

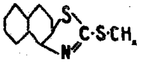


colorless needles from alcohol M.P. 232°.

4.

white needles from $CHCl_3$ M.P. 180°

5.



29. Hantsch and Weber, *Berichte*, 20, 3118 (1887).
30. Möhlau and Krohn, *Berichte*, 21, 59

Jacobson, *Berichte*, 21, 2664 (1888).
Jacobson and Ney, *Berichte*, 22, 904 (1889).
Jacobson and Schenke, *Berichte*, 22

colourless needles from alcohol M.P. 74°.

6. Phenyl-acetamino benzothiazole, colourless needles from alcohol, M.P. 167°.

All are odourless.

Gatterman and Neuberg[37] in 1891 worked out a synthesis of dehydrothiotoluidin from thioparanitrobenztoluid following out the general method of Jacobson, preparing in the course of the procedure 6 methyl-para-nitrophenyl-benzthiazole, but did not describe any of its properties. This was more interesting from a theoretical than a practical standpoint, as the synthesis involved a large number of steps, and much material was lost in the course of the reaction.

Research in the field now reached the point where investigation led to the discovery only of new compounds rather than of general reactions for the preparation of the thiazoles. O. Kym[38] prepared some of these—6 amino, 2 phenyl-benzothiazole, yellow-green leaves, alcohol, M.P. 202°; the acetyl derivative of this compound white needles from alcohol, M.P. 192°-193°; 6 amino-2 para-aminophenyl benzothiazole, yellow needles from alcohol, M.P. 237°-238°; and the diacetyl derivative of this, reddish-needles from alcohol, M.P. 272°-273°. In 1896 Lauth[39] prepared oxalaminothiophenol, two dinitro, and diamino derivatives whose structures he did not determine, and a number of azo dyes from the latter, while subsequently other special methods for the preparation of Rosenkörper were developed, among which may be mentioned that of Voswinkel[40] from benzoyl phenylhydrazine and sulphur, and Wheeler,[41] from orthoamino-thiophenol and benzimido methyl ether, while Schmidt[42] prepared 6 dimethylamino benzothiazole from dimethyl-paraphenylene-diamine thiosulphonic acid by condensation with formaldehyde and oxidation of the product with nitrous acid. Reissert[43] also did some work on the benzothiazoles, but did not contribute anything new or interesting.

As has already been noted, from a commercial standpoint, the most important compounds of this group are the so-called anhydrobases which are obtained by the direct fusion of aromatic amines with sulphur, although perusal of the patent literature shows thatl almost all of the pheny benzothiazole amines that have been prepared have also been patented. The basic patents in the dye-field are those founded upon the original work of Green and that of Anschütz and Schultz, and all may be classified according to the particular base with which they deal, into groups as follows:

1. Mono or diamino derivatives of 2 phenyl benzothiazole, or 2 phenyl alpha or beta naphthiazole. These are not very important, and there are comparatively few patents dealing with them.

2. Dehydrothiotoluidin, 6 methyl 2 para-aminophenyl benzothiazole which, as has already been noted, is the most important of all, and a large number of patents deal with its preparation as well as that of its derivatives. The experience of different concerns which have manufactured this base appears to have differed, as may be readily seen from a perusal of the patent literature.[44] The main difficulty has been the separation of the principal product from the primulin simultaneously formed, a problem which has not been satisfactorily solved although it can be done by a vacuum distillation of the fusion mixture, or by means of the difference in solubility of the ammonium salts of the sulphonic acids of the two bases as described by Noetling[45] and in the patent just given (the method was discovered by Hall in 1889). For the preparation of some of the thioflavins the sulphonic acids are undesirable, so this method has a serious objection, as up to date it has not been possible to regenerate dehydrothiotoluidin from its ammonium sulphonate.[46]

37. Gatterman and Neuberg, *Berichte*, 25, 1081 (1892).
38. Kym, *Berichte*, 32, 3502 (1899).
39. Lauth, *Bull. Soc. Chim.*, 15, 82 (1896).
40. Voswinkel, *Berichte*, 35, 1946 (1902).
41. Wheeler, *Am. Chem. Journ.*, 17, 1401 (1895).
42. Schmidt, *Berichte*, 39, 10 (1906).
43. Reissert, *Berichte*, 38, 3433 (1905). Reissert, *Centralblatt* (1905), 1599.

44. Dahl & Co., *D. R. P.*, 35790; Friedländer, 1, 536.
Kalle & Co., *D. R. P.*, 92011; Friedländer, 4, 824.
Bayer & Co., *D. R. P.*, 65402; Friedländer, 3, 752.
Casella & Co., *D. R. P.*, 53938; Friedländer, 2, 293.
Picke, Lange & Co., *D. R. P.*, 52509; Friedländer, 2, 292.
Höchster Farbw. Co., *D. R. P.*, 104, 230; *Centralblatt*, 1899 (2) 950.
45. Noetling, *Bull. Soc. Ind. Mülhouse*, 81, 172 (1911).
46. Jansen, *Zeit. Farben-Ind.*, 12, 215 (1913).

(*To be Continued.*)

CHEMICAL NOTICES FROM FOREIGN SOURCES

QUINDOLINES—*E. Grandmougin.*—When primary phenolic amines react in suitable conditions upon indigo, dianylimide-indigos are obtained. The dark blue product obtained with two molecules of aniline corresponds to the formula $C_{28}H_{20}N_4$. It is a feeble base of which, however, diacid salts can be prepared, bluish green in colour and hydrolysed by water. If it is heated with mineral acids in an acetic medium, the bluish green solution turns yellow, and in the solution there is now a new base formed by the isomerisation of the dianilido indigo, and it can be separated from the acid solution by neutralisation. Its formula is also $C_{28}H_{20}N_4$. The yellow salts are darker coloured than the base, and are not hydrolysed by water. From its behaviour, it appears that it is the anilido of a 5-indoquindolinone. It appears that one of the two molecules of aniline furnishes part of the elements for the quindolinic nucleus, and the other part comes from the half skeleton of the indigo. From this it may be deduced that a homologous quindoline would be obtained if a homologous diaryl imido indigo were used, and this conclusion has been verified by experiment.—(*Comptes Rendus*, CLXXIV., 1922, 1175.)

NEW METHOD OF MANUFACTURING BARYTA FOR THE TREATMENT OF MOLASSES—*Camille Deguide and Paul Band.*—The decomposition of barium carbonate for the treatment of molasses presents certain difficulties: At 1,500°, the temperature to which it must be heated, the product melts and attacks the walls of the furnace, and some of the baryta is lost. The authors observed that barium silicate does not show any signs of fusion at the temperature of formation, and it gives a large quantity of hydroxide with water, and they therefore were led to investigate the possibility of using it commercially. They found that the following closed cycle of reactions might he employed in the manufacture of sugar:—

$$\left.\begin{array}{l}SiO_2 + 3CO_3\,Ba \\ SiO_2\,BaO + 2CO_3\,Ba\end{array}\right\}\ SiO_2.\,3BaO$$

$$SiO_2.3BaO + Aq = SiO_2.BaO + Ba(OH)_2.8H_2O$$

$$C_{12}H_{22}O_{11}+BaO = C_{12}H_{22}O_{11}.BaO$$

$$C_{12}H_{22}O_{11}.BaO+CO_2 = CO_3Ba+C_{12}H_{22}O_{11}.$$

The mother liquors, separated from the barium sucrate, can be made to yield the nitrogen and potash derived from the soil, and from 100 kg. of molasses treated, 1 kg. of nitrogen and 6 kg. of K_2O can be obtained. —(*Comptes Rendus*, CLXXIV., 1922, 1175.)

NEUTRAL HOMOCAMPHORIC ETHERS AND THEIR REDUCTION PRODUCTS—*M. Palfray.*—When diethylhomo-camphorate is reduced, it gives the corresponding glycol, a colourless very viscid liquid which very rapidly solidifies and hardens. By the evaporation of an ethereal solution of this *glycol crystals fusing at 63-63.5 can* be obtained. The diphenylurethane, diacetyl and dibenzoyl derivatives of the glycol have all been prepared, and also the acid and alcohol.—(*Comptes Rendus*, CLXXIV., 1922, 1235.)

BECQUERELITE, A NEW RADIOACTIVE MINERAL—*Alfred Schoep.*—Certain pieces of pitchblende from the mine at Katanga (Belgian Congo) are covered with a yellow crystalline crust, consisting of a mineral which cleaves very readily. The same mineral completely fills the fissures of the pitchblende, and small crystals can be found in the cavities. The microchemical analysis shows the presence of uranium and small quantities of lead. SiO_2 and Fe_2O_3 are also present, but may be regarded as impurities. Analysis shows that the pure mineral is a hydroxide of uranium, the composition of the dried substance being

H_2O	10.78%
UO_3	89.21%

The formula is therefore $UO_3 . 2H_2O$. The radioactivity of this new mineral, for which the author proposes the name becquerelite, is almost the same as that of pitchblende. —(*Comptes Rendus.* CLXXIV., 1922, 1240.)

GRAVIMETRIC DETERMINATION OF ZINC.—*A. Gutbier and K. Staile.*—It is possible to determine zinc gravimetrically as the anhydrous sulphate, and as a control the sulphate can be transformed quantitatively into oxide by heating. The small amounts of SO_4 which remain fixed to the sulphate do not affect the analytical results if the quantities of substance employed amount to 0.1 to 0.2 gr. It is also possible to transform the oxide into sulphide quantitatively.—(*Zeitschr. f. Analyt. Chem.*, 1922, 97.)

PROCEEDINGS AND NOTICES OF SOCIETIES.

ELECTROSYNTHESIS IN ORGANIC CHEMISTRY.

(*Abstract.*)

Evening Meeting at the Royal Institution of Great Britain, Friday, April 22, 1922.

Sir James Reid, Bart, G.C.V.O., K.C.B., M.D., LL.D., F.R.C.P., Manager and Vice-President, in the chair.

Sir James Walker, D.Sc., LL.D., F.R.S., Professor of Chemistry, University of Edinburgh.

The decomposition of water into oxygen and hydrogen by means of the electric current was effected by Nicholson and Carlisle in 1800, and affords the first example of electrolysis. Davy applied the electrolytic method to the decomposition of many compounds, and finally succeeded in isolating the alkali metals, potassium and sodium, by the electrolysis of fused potash and soda.

Faraday, his successor in the chair of the Royal Institution, laid the foundations of our theoretical knowledge of the subject. He studied in detail the nature and proportions of the products obtained by electrolysis, reduced the manifold experimental data to a simple system, and invented the nomenclature employed at the present day. The process of electrolysis in aqueous solution is conceived by him as follows: When two conducting plates connected with the opposite poles of a battery are immersed in a conducting solution, negative electricity travels towards the positive plate (*positive electrode, anode*), and positive electricity travels towards the negative plate (*negative electrode, cathode*). The electricity does not travel alone, but in association with a *material carrier* or *ion*, the *anion* or negatively charged ion moving towards the anode, whilst the *cation* or positively *charged ion moves towards the cathode.* Chemically equivalent quantities of the ions bear equal charges of electricity. When the ions reach the electrodes they are there discharged, and may then act (1) upon each other, (2) upon the water in which they are dissolved, or (3) upon the material of the electrodes. Thus if we electrolyse sulphuric acid H_2SO_4, which yields the ions 2H+ and SO_4 , we have at the negative electrode an action which may be represented by the equation

$$2\,H = H_2 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

two discharged hydrogen ions combining with each other to form a molecule of hydrogen gas. If the positive electrode is of copper we have the reaction

$$SO_4 + Cu = CuSO_4 \quad . \quad . \quad . \quad (2)$$

the discharged ion acting on the material of the electrode and forming copper sulphate. If, on the other hand, the positive electrode consists of the resistant metal platinum, the discharged ion acts on the solvent water according to the equation

$$2\,SO_4 + 2\,H_2O = 2\,H_2SO_4 + O_2 \quad . \quad (3)$$

sulphuric acid being regenerated and oxygen gas evolved.

Equation (1) expresses a kind of synthesis, two atoms originally separate uniting to form a single molecule. In organic chemistry synthesis in the strict sense is held to mean the union of carbon atoms originally belonging to separate molecules. The first electrosynthesis was effected in 1849 by Kolbe, who, to take a simple example, electrolysed potassium acetate solution with platinum electrodes, and at the anode obtained the hydrocarbon ethane. The negative ion of the acetates is represented *by the formula* $CH_3:COO-$, *and* under appropriate conditions two of these when discharged at the anode interact in accordance with the equation

$$2\,CH_3:COO = CH_3:CH_3 + 2\,CO_2 \quad . \quad (4)$$

Here an organic synthesis in the strict sense has been effected, two CH_3 groups originally contained in different molecules being now joined together by their carbon atoms to form a molecule of the hydrocarbon ethane $CH_3:CH_3$. This method of synthesis was for long neglected, but attention was again drawn to it in 1890 by a suggestion of Professor Crum Brown, which was worked out in detail in conjunction with the lecturer. If the sodium ethyl salt of a dibasic acid, e.g., malonic acid $COOH:CH_2:COOH$, is electrolysed, the anion $COOEt:CH_2:COO-$ reacts according to equation (4) as follows:

$$2\,COOEt:CH_2:COO = COOEt:CH_2:CH_2:COOEt + 2\,CO_2.$$

The product, diethyl succinate, contains two CH_2 groups instead of the single CH_2 group present in malonic acid, and may readily be converted into sodium ethyl succinate, which yields the anion

$$COOEt:CH_2:CH_2:COO = COOEt:CH_2:CH_2:CH_2:CH_2:COOEt + 2\,CO_2$$

giving diethyl adigate, which now contains four CH_2 groups. This may be again converted into a sodium ethyl salt, and the process continued.

In this way it was possible to build up, starting from malonic acid, acids containing chains of 2, 4, 8 and 16 CH_2 groups. Starting from acids containing 3, 5 and 7 CH_2 groups, acids were prepared containing 6, 10 and 14 CH_2 groups, and with 6 CH_2 groups the acid with 12 CH_2 groups was prepared. Many acids with branched hydrocarbon chains have also been obtained by the method. In its simple form the electrosynthesis necessarily yields hydrocarbon chains with an even number of carbon atoms, a process of doubling taking place at each stage. However, acids containing an odd number of carbon atoms can be produced by the electrolysis of mixtures. Thus the acid containing 7 CH_2 groups has been prepared by the electrolysis of a mixture of the sodium ethyl salts of acids containing respectively 1 and 6 CH_2 groups, by the interaction of the two different discharged anions.

It is somewhat surprising that the method of electrosynthesis, an outline of which has been indicated, is not more extensively used in practice. Doubtless this is in part due to the care which must be exercised in adjusting the physical conditions in order to secure a successful result. Concentration of solution, temperature, material of electrode, electromotive force and current density at the anode all play an important part in determining the result of the electrolysis. Thus, for example, if we substitute a gold anode for a platinum anode in the electrolysis of a solution of potassium acetate, although the gold electrode is not attacked, and all other conditions remain the same, we obtain at the anode oxygen instead of a mixture of ethane and carbon dioxide. Here synthesis has not been effected: instead of the reaction of equation (4) it is now the action analogous to equation (3) which preponderates.

It is perhaps noteworthy that unlike many of the ordinary synthetic methods of organic chemistry which only succeed in unusual solvents or at comparatively high temperatures, the method of electrosynthesis yields the most successful results in aqueous solution and at the ordinary temperatures, resembling therein the synthetic processes which occur in plants and animals. [J. W.]

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, 7TH JUNE, 1922.

Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President), in the chair.

Certificates were read for the first time in favour of:—

Messrs. George Scott Robertson, D.Sc. (Dun.), F.I.C., Frederick John Martin, M.A. (Cantab.), A.I.C., Frederick Stanley Shadbolt, A.I.C.

Certificates were read for the second time in favour of:—

Messrs. Archibald Steele Whamond, Thomas John Ward.

The following was elected a Member of the Society: Mr. Frederick Major, B.Sc. (Lond.), A.I.C.

The following papers, of which the following are abstracts, were read:—

"The Action of Natural Waters on Lead," by John C. Thresh, M.D., D.Sc., F.I.C.

Following the examination of the action of distilled water on lead (Analyst 1921, 46, 270), the author now gives an account of the action of various salts commonly found dissolved in water, comparing the results with those obtained with moorland waters. He finds that the action produced is not accounted for by the presence of the small quantities of chlorides, sulphates, etc., but is due to an organic acid probably present in peat, and to a silicate, and by the addition of one or both of these the author is able to imitate any natural moorland water.

"The Composition of Cow's Milk in the Sudan," by A. F. Joseph, D.Sc., F.I.C., and F. J. Martin, M.A., A.I.C.

The observations recorded in this paper embody the results of the analyses of samples of cows' milk examined in the Wellcome Tropical Research Laboratories, Khartoum, during the last 10 or 15 years, and the authors find that the Sudan resembles other tropical countries in that the cows' milv is rich both in fat and other solids. They find the total fat production to be approximately the same morning and evening, while there is a distinct seasonal variation in composition.

"The Estimation of Meconic Acid in Opium," by H. E. Annett, D.Sc., F.I.C., and M. N. Bose, M.A.

The authors precipitate the meconic acid as its calcium salt by adding an excess of

calcium chloride solution to an avueous extract of the opium. They then wash the calcium salt, decompose with dilute hydrochloric acid, and after crystallising the meconic acid, wash, dry, and weigh it. Corrections are applied for meconic acid not precipitated by calcium chloride and for meconic acid dissolved by the hydrochloric acid under conditions used in the experiment.

"The Use of the Daylight Lamp in Volumetric and Colorimetric Analysis," by W. Singleton.

The Daylight lamps used—which are inexpensive—were of the tungsten filament type using daylight glass bulbs. The author described the advantages of the light from the daylight lamp over ordinary artificial light in increasing the efficiency of many chemical indicators. The results obtained in many titrations using indicators in natural daylight, artificial daylight, and ordinary artificial light were given, it being found that the range of colour covered by the end-point with many indicators was shorter and more accurately observed in artificial daylight as in natural daylight. In addition to increasing the accuracy of these titrations, the use of the daylight lamp greatly increased the ease by which this accuracy could be attained.

SOCIETY OF GLASS TECHNOLOGY.

"Columnar Structure in Sandstone Blocks."

(By John Currie, M.A.).

A meeting of the Society of Glass Technology was held in the Chemistry Lecture Theatre, University College, Gower St., London, W.C.1, on Wednesday, May 17th, 1922, at 3 p.m., the President, Prof. W. E. S. Turner, D.Sc., in the chair.

In the absence of the author, the above paper was read by Mr. S. English, M.Sc. In the course of his paper the author said that an interesting example of superinduced prismatic structure had recently been observed in sandstone blocks used in the construction of a glass tank-furnace. The formation was identical in every respect with that which takes place in Nature, particularly in the case of a columnar basalt, and was, in fact, a reproduction of contact metamorphism on a small scale.

The tank in question was used for the manufacture of green bottle glass. The melting compartment measured 19 feet by 15½ feet, and was separated from the rounded working end by a fixed bridge. The dead weight capacity of the tank was approximately 84 tons, when filled to a depth of 3 feet. The construction of the tank was on the ordinary lines, the bottom being of fireclay binders built into a series of six arches. Sandstone blocks formed the lowest course of the sides, and these were surmounted by two courses of fireclay blocks. The fireclay blocks were of the same dimensions, so that the depth of metal in the full tank was 36 inches.

On November 18th, 1921, the tank sprung a leak in the bottom somewhat towards the south side, and about 9 feet from the back wall. The metal drained rapidly through this leak into the cave below, the level in the tank falling from 37 inches to 9 inches in the course of six hours. The gas was kept on all this time, and a full heat of 1,300° C. maintained so as to preserve the fluidity of the metal and allow of its removal both by ladling and by draining through the bottom. However, when the metal level had reached 9 inches, part of the crown collapsed directly above the leak in the bottom, and, to avoid setting fire to the roof of the building, the gas had perforce to be cut off.

The metal falling through the tank bottom into the cave beneath assumed a stalactitic formation, which rapidly solidified and prevented further flow of the metal. But as each successive column was broken away, the flow was renewed, with the result that the level of metal in the tank was lowered from 27 inches to 9 inches in a period of six hours.

After the tank was dismantled, it was observed that the sandstones readily disintegrated into long prismatic columns, many of which were straight, but most of them showing a decided curvature which helped to explain the method of their formation. These prisms were roughly pentagonal in section, and varied in thickness from half-an-inch to an inch and a half. The faces of the prisms were not equally developed, and moreover some of the columns were trigonal, others tetragonal in form. Similar formations were found in Nature, and when this structure was fully developed, as in the well known rocks of Fingal's cave and

Giant's Causeway, the columns tended to assume hexagonal form.

Again many of the columns were incomplete, and tapered off to a point in pyramidal fashion. Also they were intersected at more or less regular intervals by transverse or cross-joints, so that on disintegration the sandstone tended to break up into short columns five or six inches long, some of which were regularly prismatic, others tapering off to a point coincident with the plane of a cross-joint.

This prismatic structure was always developed at right-angles to the planes of cooling. In the space of a few hours the sandstones, which normally were at a temperature not exceeding 800° C., were raised to a temperature of 1,300° C. Expansion took place rapidly, and then the heat was suddenly cut off. The crown of the tank being open, cooling was rapid, and the sandstones underwent sudden contraction, resulting in complete rupture at right angles to the inclined surface of the corroded stones, representing the plane of cooling. Hence the reason for the curved and inclined nature of the columns obtained.

The whole of the evidence went to prove that the formation started at the point of contact with the glass, and that in this instance, as had already been claimed for similar formations in Nature, columnar jointing was distinctly related to the planes of cooling.

Dr. J. W. French has obtained specimens of a similar formation by the rapid cooling of a pot of optical glass. In this instance the sudden contraction caused the rupture to commence near the centre at the surface of the glass, the prismatic formation of the glass extending from that point radially towards the bottom of the pot, and continued in the clay forming the pot itself.

The two cases, although essentially of a different nature, are very similar as to the primary cause and final results, and form an interesting comparison.

Mr. F. W. Adams, M.Sc., followed with a paper entitled, "Some Practical Notes on the Manufacture of White Glass in a Tank Furnace."

During the forenoon, by the courtesy of the directors, a party of members visited the Whitefriars Glass Works of Messrs. J. Powell & Sons (Whitefriars), Ltd., London.

The next meeting of the Society will be held in the Applied Science Department, The University, Sheffield, on Wednesday, June 21st, 1922, at 2.30 p.m.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY, JUNE 15TH, 1922, AT 8 P.M.

The following paper will be read:—

Ring-chain tautomerism. Part III. The occurrence of tautomerism of the three-carbon (glutaconic)type between a homocyclic compound and its unsaturated open-chain isomeride. C. K. Ingold and E. A. Perren.

THE INSTITUTE OF METALS.

PRESIDENT, LEONARD SUMNER, ESQ., O.B.E., M.Sc.

The Annual Meeting of the Institute (the first to be held by the Institute in Wales), will be held at Swansea, on Wednesday, Thursday, and Friday, the 20th, 21st, and 22nd of September.

Members will assemble in Swansea on Tuesday, September 19th, during the afternoon of which day the Honorary Local Secretary's Office will be open for the distribution of Papers and Invitation Cards. On September 20th, at 10 a.m., there will be an Official Welcome by the Mayor, and the remainder of the morning will be devoted to the reading and discussion of papers. After an official Luncheon, a visit will he made to the University College at Singleton, where tea will be provided.

In the evening there will be a reception by the Mayor.

On September 21st the morning will be devoted to the reading and discussion of papers, and after luncheon there will be visits to works, the evening being devoted to entertainment.

Owing to the exceptionally interesting series of papers to be presented, it may be necessary for a morning session to be held on the concluding day of the meeting, Friday, September 22nd, but arrangements will be made for motor excursions in the district, in which there is beautiful coast and inland scenery.

It is desirable to point out that only Members and Student Members will be entitled to participate in the Swansea meeting, and that for the convenience of applicants for membership who are desirous of being elected in time for the meeting, a special ballot is being arranged in connection with which membership application forms should he received by the under-

signed not later than noon on Thursday, July 13th. The ballot will be concluded in time for Members and Student Members so elected to participate in the Swansea meeting. It is hoped that members will be good enough to bring this notification to the knowledge of those who may be desirous of applying for membership of the Institute.

GENERAL NOTES.

ACETIC ACID IMPORTS.

In the House of Commons last week, Mr. George Thorne asked the President of the Board of Trade what proportion of the £42,353 worth of acetic acid imported into this country during the six months ending 31st March last represented grades which had since been deleted from the list of dutiable commodities.

Mr. Baldwin said that the particulars required to be furnished with respect to acetic acid imported during the period specified did not necessarily distinguish between the various grades of the commodity, and he was consequently unable to furnish the information desired.

REPARATION DYES.

Major Mackenzie Wood asked the weight and value of reparation dyes handed over by his department to the Central Importing Agency during the financial year 1921-22; the amount realised for them, and the amount of commission paid to the Central Importing Agency for the sale; what commission the Central Importing Agency charged to purchasers; and whether the President of the Board of Trade was now prepared to put these goods up for competitive tender rather than give the monopoly to one firm?

Mr. Baldwin replied: The quantity of reparation dyes handed over by the Board of Trade to the Central Importing Agency during the financial year 1921-22 was 686 tons, valued at 33,300,000 paper marks. The amount realised during the year 1921-22 from sales was £293,323, and the commission paid to the Central Importing Agency on those sales and in respect of services rendered in connection with dyestuffs allocated to the Dominions, was £18,020. A charge is made by the Agency, on sales which they make, of 1 per cent., which is accounted for to the Board of Trade. As regards the last part of the question, I must point out that even if the reparation dyestuffs were sold by tender as suggested by the hon. member, some organisation would be required to carry out the services at present carried out by the Agency.

BRITISH DYESTUFFS CORPORATION.

Mr. Baldwin, in reply to Rear-Admiral Adair, said that the Government directors of the British Dyestuffs Corporation were Lord Ashfield and Sir Henry Birchenough. both of whom had much experience in the direction of large industrial and commercial undertakings.

Rear-Admiral Adair: Does the right hon. gentleman appreciate the fact that, although the nation has £1,750,000 invested in this concern, it has already lost about £125,000?—Mr. Baldwin: I am quite aware of that.

DUTY ON VACUUM FLASKS.

Mr. Charles White asked why laboratory vacuum flasks were liable for duty under the Safeguarding of Industries Act, while ordinary vacuum flasks were exempt as not being scientific appliances or instruments. in view of the fact that many glass articles in the nature of toys were also dutiable.

Mr. Baldwin replied: Laboratory vacuum flasks are included in the list of articles dutiable under the Safeguarding of Industries Act because they fall within the scope of the general heading, "Scientific Glassware," in the Schedule to the Act. Ordinary vacuum flask food containers cannot properly be regarded as included in this or in any other general heading of the Schedule, which is the only question which the Board of Trade have to determine.

The British Non-Ferrous Metals Research Association (Temple Row, Birmingham) has recently carried out an extensive research on the influence of gases on high grade brass. At the Research Laboratory, Woolwich, a further investigation is now being made by the Association with the co-

operation of the Engineering Co-ordinating Board of the Department of Scientific and Industrial Research. The chief object of the present work is to study the conditions necessary for securing both surface and internal soundness of strip brass ingots such as are required for cold rolled sheet metal.

NOTES ON BOOKS.

Food Values, What they are and How to Calculate Them, by MARGARET McKILLOP, M.A., M.B.E., Fellow of King's College for Women, University of London. Second Edition, revised and enlarged. Geo. Routledge & Sons, Ltd., London. New York: E. P. Dutton & Co. 1922. Price 3s. 6d. net.

The first edition of this useful book has met with such appreciation that it has been found advisable to issue a second edition, in which some of the more important subjects treated have been brought up-to-date and new methods are introduced for estimating nutritive requirements of individuals in calories.

The writer acknowledges her indebtedness to an American publication, "Feeding the Family," for tables and other information.

Much has been written recently as to the necessity for introducing the chemist and chemical research into industries generally, and it very naturally follows that the introduction of the chemist into that sphere of life devoted to the preparation of our daily food should be equally necessary.

The author brings the science of chemistry into the kitchen very strikingly, and the valuable information that is introduced into the first few chapters is written in such a manner as not only to be easily grasped but also to form most interesting reading for the intelligent housewife, cook or chef.

The first chapter deals with the elementary chemistry of foodstuffs—sugar, starch, proteins, &c.—and chemical methods for determining their amounts in different samples of foodstuffs. Chapter 2 deals with our need of food, and how that need is satisfied. Comparing food given to a human being with the fuel supplied to a steam engine, the method of heat measurement is very simply and clearly discussed, and the value of the calorie is explained.

This chapter is followed by tables showing the food requirements of men, women, children, &c., measured in calories. A German table is given, showing the units required from the age of 1 year to 60 and over. The amount increases from 28.6 at one year, and appears to reach a maximum between the ages of 25 and 29. From that age to 60 and over, the figures are the same.

Tables are given of a very large number of articles used as food in daily life, with their composition in water, protein, fat, ash, &c., with their heat values in calories per pound. This is followed by a chapter explaining the use of the tables. It is certainly interesting to read the analysis of a meal of stewed steak for four persons in percentages of protein, sugars, fats, &c., in calories to 2 or 3 places of decimals.

The book will be found of great value for cookery classes, and to teachers of domestic economy, but it would be a very good thing if it could find its way into general use in the British home kitchen. The waste of food through ignorance of the science of cookery is too well known to everybody to need pointing out, and we have arrived at a time when it is becoming more and more necessary for everybody to make the best use of the foodstuffs available. We can thoroughly recommend the book, not only to the teacher, but to the general reader.

An Introduction to the Chemistry of Radio-active Substances, by A. S. RUSSELL, M.A., D.Sc. John Murray, Albemarle St., London, W. 1922. Price 6s. net.

The author's aim is to bring the chief facts that are known concerning the chemistry of radio-active substances together in a small compass, so that students who are interested may be able to follow this rapidly developing subject to the present day.

In the preface there is given a list of works from which can be gathered primary sources of information on radio-activity.

The book commences with introducing the minerals containing uranium and thorium, and a summary of the historical developments of the subject, the disintegration theory, and speculations as to the structure of the atom, isotopes, types of radio-active elements, &c.

This is followed by the analytical chemistry of uranium and thorium. The final chapter is devoted to the discussion of the radio elements as indicators and the extreme sensitiveness of the method is explained. It is stated that a quantity as small as 10^{12} milligrams of Th.B. can be detected by the methods of radio-activity.

The author shows a thorough mastery of the subject, and the book will be found of the greatest use to students in radio-activity.

The Tutorial Chemistry, Part II.: *Metals and Physical Chemistry*, by G. H. Bailey, D.Sc. London, Ph.D. Heidelberg. Edited by William Briggs, LL.D., M.A., B.Sc., F.C.S. *Fourth Edition.* Twelfth Impression. W. B. Clive, London. University Tutorial Press, Ltd., High St., New Oxford St., W.C. Price 7s. 6d. net.

In the present edition new chapters have been introduced on colloidal solutions and adsorption and on atomic numbers. The treatment of the subject of radio-activity has been revised and enlarged, and other minor alterations have been made in the work. The value of the book for tutorial purposes is well known, and the questions enumerated at the end of each chapter are of undoubted value, both to the teacher and the student.

The authors have thought well to remove the chapter on spectrum analysis from the body of the book to make room for one on colloidal solutions. This seems to us to be rather a pity, on account of the growing use of the spectroscope in all analytical work. We should have liked to have seen the chapter on spectroscopy brought more to the front. A table of atomic weights is given at the end of the book, and there is a comprehensive index.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry, by J. W. Mellor, D.Sc. Vol. I., pp. XV. + 1,065, with 274 diagrams. London: Longmans, Green & Co., 1922. Price £3 3s.

This is the first volume of a work which is to consist of six or more volumes, and aims at giving a complete description of all the compounds known in Inorganic Chemistry. A special attempt is being made to discuss the subject from the point

In the small space available, it is impossible to mention all the subjects dealt with, and even if it were, no useful purpose would be served; suffice it to say that, as this volume is mainly of an introductory character, most of the generalisations, which will be required for application to special cases occurring in subsequent volumes, have been discussed in detail; and, in addition, the chemistry of hydrogen and oxygen and some of their compounds has been dealt with.

Although the author states that the newer work on the structure of atoms and the so-called elements with variable atomic weights will be described in Volume IV., as a sequel to the radioactive elements, it is unfortunate that he should have asked the question (p. 200), "Are Atomic Weights whole numbers?" and answered it in such a way as to leave one with the impression that the atomic weights are best represented by whole numbers. It appears to us that it would have been advisable to have made some reference, at this juncture, to the recent work on "isotopes" which has provided us with such a satisfactory explanation for the values of the atomic weights obtained up to the present, and so removed any possible misunderstanding.

The impression one obtains from a perusal of this volume is that the work, when complete, will be an enlarged edition of the author's well-known "Modern Inorganic Chemistry," and we are delighted to find that as a result of the expansion, the clear, eminently readable style, which characterised the author's previous work, has not suffered in the slightest degree. In anticipation that the work will serve as a standard work of reference, great attention has been paid to the matter of giving the references for the statements made, and apparently with great success. In conclusion we should like to add that, judging from the excellence of this volume, it is probable that this work will prove to be one of the greatest contributions to the literature of chemistry to be made during the present decade.

Dictionnaire Anglais-Français-Allemand de mots et Locutions intéressant la Physique et la Chimie, by R. Cornubert, Ingénieur Chimiste, Docteur ès Sciences Physiques. Pages: XXXI. + 297. Paris: Dunod, 47 et 49, Quai des Grands-Augustins, 1922. Price: With

This work, as its title implies, does not claim to be a complete English-French-German dictionary. It is compiled to aid chemists and physicists who require help in the translation of scientific and technical matter not appearing in their own tongue.

Although this dictionary has been compiled by a Frenchman, and so is naturally arranged more especially from the Frenchman's point of view, yet the plan which has been followed enables the Englishman and German to use it to almost equal advantage. This end has been attained by arranging the three languages side by side in parallel columns, whilst, at the same time, a fairly strict alphabetical order has been maintained. Owing to the similarity of many of the words in the three languages, much space has been saved thereby, and the result has been the production of a volume which is convenient for reference.

There is little doubt that owing to the specialised use of words and phrases for the description of physical and chemical phenomena that a dictionary of this kind is required in all scientific and technical libraries, and provided this work is purchased bound, it may be relied upon to render good service.

The Non-Benzenoid Hydrocarbons and their Simple Derivatives, by BENJAMIN T. BROOKS, PH.D. Pp. 612. New York: The Chemical Catalog Company, Inc. 1922. Price $7.00.

The benzene hydrocarbons have been studied very fully, and in a systematic manner. But whilst a good deal of work has been carried out in connection with the aliphatic and cyclic non-benzenoid hydrocarbons, much remains to be accomplished, and the results so far accumulated still remain unconnected, and their theoretical and practical significance has been largely overlooked.

Doctor Brooks is anxious to stimulate enquiry in this branch of organic chemistry, and as he points out, the higher members of homologous senes receive scanty and often inaccurate treatment in textbooks.

The compounds studied include the paraffins, the acyclic unsaturated hydrocarbons, the polymethylenes, and the terpenes and their various derivatives, and related compounds, in so far as these bear upon the subject. In this respect the book goes farther than its title suggests.

As is pointed out, the nomenclature of spiro- and other bridged ring hydrocarbons is unsatisfactory. Of the systems proposed, that of Prof. Thorpe and his co-researchers is the simplest, and should find general acceptance.

The author has included the latest published results of Russian, German, Freuch and English chemists in widely different fields of enquiry, and his book should appeal strongly to both academic and industrial organic chemists. J.G.F.D.

THE RE-ESTABLISHMENT OF THE GOLD-BASIS OF CURRENCY.

By H. R. SLEEMAN.

This paper is an attempt to stimulate the interest of those concerned in mining, and especially in British gold-mining, in the re-establishment of gold as currency. Producers are concerned with two main factors: the cost of production and the market value of their products. The former is a technical subject, the latter a commercial subject which involves wide economic considerations. With gold producers the latter is at present the more important and the more pressing factor.

The technical aspect has been the subject of close professional study for years. There is no prospect of such immediate improvements therein as will greatly affect the industry's position. The latter has been greatly and adversely affected by the events of late years. A large part of the pre-war market for gold has been eliminated. If the pre-war market can be re-established, the benefit will be far greater than can be achieved by any improvements in working technique than at present appear feasible. To discuss how this can be effected is my object.

It is not suggested that gold should be re-established for the benefit of gold producers. The issue concerns mankind. It is for their benefit that the thing should be done. My point is that the gold producers, being specially and directly concerned, should make it their business to convince the public that it is a benefit, and indicate the way to effect it.

It seems the world's way that, however beneficial certain reforms may be to the community, they are not effected unless those imediately concerned take up the fight. No one else regards them as his own affair.

[Extract from Paper recently submitted to the Institution of Mining and Metallurgy.]

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Latest Patent Applications.

13623—Air Reduction Co.—*Manufacture of alkali cyanides.* May 15.

13835—Casale, L.—Catalysts for synthetic of ammonia, etc. May 1.

14327—Coulbeaux, P.—Chemical treatments for refining, etc., metals. May 20.

14331—Jackson, E. L.—Chemical indoor closet. May 20.

13988—Lisholm, J. H.—*Producing a solution of* cyanamide from calcium cyanamide. May 17.

14195—Mackay, H. S.—Roasting metallic ores. May 19.

Specifications Published this Week.

179201—Dyson, W. H.—Purification of metallic ores and residues containing metallic oxides.

171962—Rheinisch Nassauische Bergwerks & Hutten Akt Ges.—*Process for producing zinc* dust having a high percentage of metallic zinc.

179309—Wade, H. — Manufacture of thorium nitrate.

168576—Glysyn Corporation.—Manufacture of trichlorhydrin.

159194—Brat, P.—Recovery of ammonia from peat or the like.

163685—Chemische Fabrik Weissenstein Ges.—Process for distilling sulphuric acid.

Abstract Published this Week.

Silicates, treating; alkaline sulphates.—Patent No. 177736.—A new treatment of silicates, such as potassium-bearing silicates and clays, in order to recover their constituents in commercially available form has been invented by Mr. E. Levitt, of 323, Grosvenor Avenue, Westmount, Montreal, Canada. The silicate is fused with boren trioxide, or any substance that yields boren trioxide at a high temperature, and the resulting melt suspended in water and treated with sulphur dioxide. Bisulphites of the metals present pass into solution, while silica remains undissolved and is filtered. The filtrate is boiled, whereupon sulphur dioxide is evolved, the bisulphites converted to sulphites, and aluminium precipitated as hydroxide. The precipitate is filtered and the filtrate boiled, with access of air to oxidize sulphites to sulphates. At the same time any iron present is precipitated and filtered. The filtrate then contains sulphates of the alkali metals, if present, and boric acid. The constituents are separated by fractional crystallisation, and the boric acid used again.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3245

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

ANNUAL CONFERENCE, 1922.

ADDRESS BY THE PRESIDENT (MR. J. PALEY YORKE).

I am conscious at this moment the word Education is one of the most unloved words in the political and social vocabulary It was never very popular: it was never a favoured child: it was never regarded as a winner of election votes. There have been moments in the course of its life when it has been looked upon enquiringly and even favourably, but they have been rare and of very brief duration. We have been witnesses of the most wonderful of those moments; that moment during the late war when Education was hailed by all and sundry as the very life-blood of national life. That branch of it in which we are particularly interested—Technical Education—was singled out for special praise and declared to be of vital importance for future national development, and—incidentally—for the purpose of winning the war.

We were proud men and women in those days. It was splendid to feel that, at last, the place of education in this nation's life had been recognised universally and openly proclaimed.

To-day we look back upon that brief and transient period and ask ourselves whether it could have happened. If we had to base our answer on the attitude of those whose vision is distorted by the lenses of a false economy and who would impress that vision upon the minds of national and local governments, we should declare roundly that it was impossible to think that Education had been appraised and that proposals had been made for the extension of educational facilities so recently as 1918.

On the other hand if we base our answer upon the general attitude of the individual parent, in every walk of life, we have the greatest difficulty in understanding the position of those responsible bodies who repudiate educational development in the name of the electorate! I think that I am right in saying that there was never a time—in England at any rate—when the individual was so keenly alive to the necessity of education for his child as he is to-day. There was never a time in our history when the average individual made greater sacrifices in order to give his child a better and a longer educational training.

Therefore, there is no need for despair. Terrible as it is to think that knowledge should have been appraised at its highest in those days of war when it was being eagerly sought for the destruction of other lives and the defence of our own, and repudiated in these days of peace when it should be repairing, creating and developing, there is no need for despondency and gloom.

Rather must we gird up our loins and show to the post-war generation of national and local governors what should be the position of Education in the social, industrial, political and moral life of the nation.

It is extremely likely that many worthy people will immediately reply—with some irritation, too—that they know all about the importance of education and all that sort of thing, but that the financial position of the country will not admit of any kind of educational development. They will even declare that retrogression is necessary. That, in fact, is the position of all those who seek for "cuts" in educational expenditure. It is a position comparable to that of a farmer, who having passed through a bad year decided that the only way to secure his future would be to purchase and sow a less quantity of seeds, to expend less labour upon the tilling of the ground, to reduce the quantity of his live stock in order to save the cost of feeding them, and to so reduce his staff of labourers that those remaining could neither cope with the weeds amongst the crops nor gather in the products of the farmstead.

Somehow or other, I do not think that "hard-headed business men" would recommend such a procedure to the farmer. (It may interest hard-headed business men to know that they are the bogey which is always held up to frighten away any proposal for educational development which may involve some expenditure—the idea being that hard-headed business men never authorise expenditure at all!)

Now let me say at once that we know that taxation is high: we know that there is a general and natural desire that it should be reduced as soon as possible and as much

as possible, and we know that there is a general desire for economy in administration. We are parties to these things, and would urge that economy should always be practised because it is only another word for efficiency. Our complaint lies against the misrepresentation of these natural desires and the assumption that the public generally are only anxious to save something on the taxes and rates, and do not care what branch of public service is stripped so long as they share the loot.

All expenditure on public services should be open to criticism, but the criticism should be made in a spirit of understanding. It should be considered whether the service for which expenditure is required is necessary service. If that were agreed, it should then be considered whether the service rendered on account of the expenditure is efficient service or not. If it be efficient service and necessary service, then there is no further discussion. If it be necessary service but inefficiently performed, then immediate steps must be taken to improve its efficiency. If the service be unnecessary, either as a whole or in part, the whole or the part should be abandoned.

I know, of course, that, simple as all this appears, the difficulty lies in deciding what is "necessary service." I submit that the education service could never be regarded as "unnecessary"—though I have some hesitation in putting forward such a sweeping suggestion since I recognise that I have some vested interests in the cause of education.

This Association of Teachers in Technical Institutions is concerned with the interest of what is known as—or, to be more exact, what is called—Technical Education. So sure are we that it is a necessary service, that it is a service upon which industrial development depends, and that it is a service of great educational and social value, that we court enquiry and investigation in every possible way. Particularly do we urge for the appointment of some qualified Committee to enquire into the position of Technical Education in our educational system, to advise whether or not its development should be promoted, and if so to advise what measures are necessary for its promotion in the interests of industries and professions which depend upon the application of science.

A resolution on that matter will be put before the Conference this morning, urging the necessity for a complete review of the whole field of Technical education, not only in its relation to industry, but to every phase of national life.

In his presidential address last year, Prof. Knox traced the rise and growth of Technical education eloquently and lucidly, and he made out an unanswerable case for its fundamental economic importance to industry.

What is Technical Education?

If I make any special point in this address it would be this—that in addition to its economic importance to industry, Technical education is definitely education, and is as essential, educationally and culturally, as any other branch of educational activity.

There is a tendency on the part of Education Committees and educationists, to stress the adjective, "Technical," and to give to it both a meaning and an emphasis which it should not have. I am convinced from my contact with people interested in education that Technical education is generally misunderstood. Some think that it is something like a glorified kindergarten system. Others think that it is a sort of make-believe education in which the pupils are beguiled into learning a little by playing a lot. Others think of it as a social movement in which by bribes in the form of entertainments, dances and social evenings, a little instruction is unwittingly imbibed. There are others who think that our Polytechnics and Technical Institutions have not advanced one step past the Mechanics' Institutes of 100 years ago. There are others who think that Technical education means the teaching of trades—and are scornful and suspicious in consequence. If it did profess to teach trades I should be amongst the scornful and suspicious. There are others who think that Technical education begins and ends with the making of "soap tidies" and other domestic conveniences.

Finally, in the list of misunderstandings, there are those who hold the idea that Technical education is something which is only for artisans, and that those who have partaken of it are only fitted to be artisans in consequence. This view is serious and deplorable, because it is a view which appears to be held by those who would claim to be counted in the ranks of cultivated people.

This idea and all the other false ideas must be rooted up and the truth planted in their places. It is now 40 years since any national enquiry on technical education was made. The advance of scientific knowledge and the development of the applications of science to industry and manufacture since that time have been tremendous. Technical education has developed, too—for it is the connecting link between science and industry—but it has developed almost furtively and unobtrusively—it has developed beyond the recognition of many of those who imagine themselves to be its guardians. Certainly it is time that enquiry was made in the national interest.

Those of us who seek to advance the cause of Technical education have often heard that we were preaching a gospel of utilitarianism which could not be recognised in any educational scheme. Technical education has been accused of soullessness.

That is somewhat similar to the charge which Goethe levelled at Newton. The poet contended, in effect, that the glory had gone out of the rainbow when Newton showed that white light was composite and might be split, by means of a prism, into the glorious colours of the spectrum. To the scientists the glory and beauty of the rainbow were enhanced and the marvel of it was increased rather than diminished.

Technical Education is essentially scientific education coupled with education in arts and crafts. Your scientist is the least dogmatic of persons: the least cocksure: the first to tell you that he does not understand *why*. Ask him the function of science and he will tell you that it is *to describe and not to explain*. What are his theories but imageries—fantasies, if you like—poems—epics—flights of imagination by which he would describe some phase of nature and conjure up some mental picture that we may marvel at. We protest most strongly against the charge of soullessness. At the same time we do not say that education shall consist only of science and its application. We ask for modern languages, literature, arts and crafts, and contemporary international relations as studies in our Technical Institutions, and we do not admit that what is commonly called a good general education can only be obtained by the study of certain subjects in certain ways, or that education and culture must be associated necessarily with bygone civilisations. Even if it be conceded that a general knowledge of ancient history is necessary, and that an deemed desirable, must they be obtained by years and years of toil and weariness from the dead languages?

May I quote the educationists of China? There, the general desire is to acquire what is best in the modern world, but they do consider that the existence of specialists having a knowledge of the classics to be eminently desirable. The function of these specialists is to dig deeply into classic lore and to unearth all things which would seem to be of value historically, artistically, literally and scientifically, and make them known.

THE ESSENTIALS OF A GOOD EDUCATION.

It does not appear to be recognised sufficiently that the sum total of human knowledge is so enormous that no one man can have more than a smattering of most of it. It is almost essential and inevitable that specialisation must be undertaken. Every different trade, profession or occupation represents a form of specialisation, and within any one profession specialisation is essential. It was not always so; but the sum total of human knowledge was not as great as it is now, and was not being added to at the rate at which addition takes place today. It must be recognised that as a body the human race must be smatterers, and that each individual must be a smatterer in most things and something of a specialist in one. Were it demanded that each one of us should attain in all things a standard of proficiency represented even by some such standard as the London Matriculation or the School Leaving Examinations, we should never be able to leave school, and nobody would ever pass beyond that standard. That is clearly an impossible position.

I would not urge that every child should start to specialise from his cradle, but I do urge that the time has come when very careful consideration should be given to the question, "What are the essentials for a good general education?" And by a good general education I mean such training and such knowledge that will develop a child's mind and create in him the desire to read and the ability to reason, to enquire, and to understand where understanding is possible; training, too, which will develop his body and bring body and mind into greater unison, and training which will develop his imagination, his courage, and that too rare gift, the gift of being able to marvel at the wonders of "nature" and to appreciate the beauties of life.

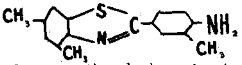
DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By Martin Meyer, B.Sc., M.A.
New York City.

(Continued from Last Week).

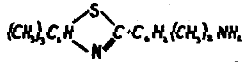
From the practical side the application of the dyestuff is as important as its preparation, and some of the methods of substantive cotton dyeing as applied to primulin are discussed by Haller,[47] while in the experimental part of this paper an adaptation of the Badische method which works fairly well for laboratory purposes, is given.

3. Dehydrothioxylidins, of which the commercially important one is the meta compound



prepared as mentioned above by Anschütz and Schultz, and described in the Bayer Patent already given.

4. Dehydrothiopseudocumidin, also prepared by Anschütz and Schultz and covered by the Bayer patent, which, however, does not mention which of the two isomers is meant—



5. 6-Para-aminophenyl dehydrothiotoluidin, prepared from benzidine and paratoluidine and the corresponding tolidine compound, covered by several patents which may be found in the third volume of Friedländer.

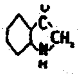
6. 6-6 Bisdehydrothiotoluidin, prepared also from benzidine and paratoluidin, and the corresponding tolidine compound, which are really further condensation products of those in group 5.

7. Bases of unknown or uncertain structure, such as primulin, the chromins, etc.

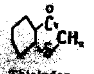
From these seven groups a large number of dyes have been made which fall more or less naturally into sub-divisions: (1) Those bases which are themselves direct colours on cotton, as for example, primulin and chromin; (2) alkylated bases, or alkylated and sulphonated bases such as thioflavins; (3) substituted bases, nitro derivatives, etc., which are comparatively few, although nitro derivatives of dehydrothiotoluidin have been made and used as dyes; (4) oxidation products like naphthamine yellow produced by the action of bleach on dehydrothiotoluidin, and (5) azo dyes which are by far the greater majority, and can be conveniently sub-divided into monoazo and bisazo compounds, and both of which are represented in larger numbers.

The colours of these dyes are in the main confined to the red-yellow end of the spectrum, although in the derivatives of groups 5 and 6 some blues and greens are found. A series of greens may also be obtained by coupling diazotized dehydrothiotoluidin with the naphthyl-amine sulphonic acids, rediazotizing and treating with dioxy naphthalene disulphonic acids. It is interesting to note in passing that while primulin can be diazotized on the fibre as was shown by Green in his original work, this process is not possible with dehydrothiotoluidin. These dyes are all direct substantive ones for cotton, are reasonably fast to acid, alkali, and bleach, but as has been noted by all the workers in the field, only moderately so to light, a thing which, of course, reduces materially their value.

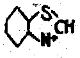
This fact brings up a rather interesting point in connection with structural relationship of organiccompounds. The indigoid and thioindigoid dyes are amongst the fastest of all toward light, and owe a great deal of their commercial importance to this fact, as well as, of course, to the wide variety of colours that can be obtained from them, particularly in the case of the latter. There is a rather close genetic relationship between some of the thiazoles and the corresponding compounds in the indigo series as may be seen at a glance from comparison of the accepted structural formulæ:



Indoxyl



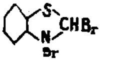
Thioindox (Thionaphtl



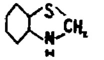
Benzothiazol

47. Haller, *Farber Zeit.*, 25, 301-306, 1914.

Benzo-thiazole may be regarded as derived from indoxyl by replacement of the carbonyl group with a sulphur atom and removal of the two hydrogen atoms, and oxalamido-thiophenol as bearing a corresponding relationship to indigo. As already mentioned, it has been observed by several workers that the thiazoles from dibrom addition products, and from similar reactions, we should expect the compound which Gatterman did not investigate, to have the formula



and to be reduced to



which would make it resemble indoxyl still more closely, and then reasoning along the same lines, we should still be able to obtain the analagous reduced oxalamido-thiophenol both by reduction of the bromine addition product which has noa been made, and by oxidation of the postulated dihydromethenyl base. If the accepted view of the cause of the color of the indigoid dyes is correct, we should not expect the compound to be a dye.

APPENDIX TO THE HISTORICAL REVIEW.

1. Friedländer devotes a chapter of each volume of his work to patents dealing with sulphur dyes, most of which refer to the so-called anhydro bases, and the large majority of them are descriptive of azo or bis-azo dyes. Among the substances with which dehydrothiotoluidin has been diazotized and coupled may be mentioned by way of example: salicylic acid; beta naphthol; beta naphthol alpha or beta monosulphonic acids; phenols and cresols; itself, primulin, and their sulphonic acids; tetrazodiphenyl or tolyl; naphthionic acid; ammonia; metatolylene diamine; beta naphthylamine sulphonic acids; resorcin; oxynaphthoic acid; naphthol disulphonic acids; dyes such as chrysoidin and Bismark Brown; alpha naphthylamine sulphonic acids; Clève's acids further diazotized and coupled with compounds already given; and the aminonaphthols and their mono and disulphonic acids and ethers.

2. To substantiate the conclusions arrived at regarding the second and third purposes of this research, the following partial list of compounds which have been prepared by previous workers together with their properties, in addition to those already mentioned and others which will be described, is given. These are all benzothiazole derivatives and merely the substituting groups and their positions are indicated for the simpler ones.

Groups.	M.P.	Odor	Colour.
benzothiazole	210°	aromatic	none-white
2 chlor	M.P. 24° B.P. 248°	,,	,,
(?) nitro 2 chlor	192°	none	,,
2 hydroxy	139°	,,	,,
2 ethoxy	25°	aromatic	,,
2 acetoxy	60°	none	,,
2 amino	129°	,,	,,
2 phenylamino	159°	,,	,,
2 methyl	B.P. 238°	aromatic	,,
2 ethyl	B.P. 252°	,,	,,
2 butyl	Not found	not given	,,
S2 dibenzothiazole ethane	137°	none	,,
p 2 dibenzothiazole benzene	112°	,,	,,
2 oxymethyl	176°	,,	,,
2 benzyl	....	—	,,
2 orthohydroxyphenyl	129°	none	,,
S-phenyl benzothiazole ethane	111°	,,	,,
6 methyl	M.P. 15° B.P. 255°	aromatic	,,
2, 6 dimethyl	No data		
6 methyl 2 phenyl	125°	none	none
2 phenyl naphthiazole	100—101°	,,	,,
naphthiazole	45°	,,	,,
2 methyl naphthiazole	No data		

DISCRIMINATION BETWEEN CÆSIUM AND RUBIDIUM.

By John Missenden, B.Sc.

The great similarity that the two metals *cæsium* and *rubidium* have for each other, used to present considerable difficulties to past researchers. The usual blowpipe methods and wet reactions are useless, while the semblance of these metals to potassium is evidenced in their general affinities. The only way whereby they may, in their elementary state, be recognised is by *careful spectrum analysis, and the spectra projected are so distinctive that* the presence of these metals may be detected with perfect certitude for extremely small quantities.

In the spectrum of cæsium may be seen two vivid blue lines (Cs $=4557$ and Cs$\beta=4592$), as well as many others less clearly defined; while rubidium produces two lines of the violet order (Rb $=4200$ and Rb$\beta=4237$), and two other lines of the red order (Rb$\delta=7953$ and Rb$\gamma=7810$). Considering the latter element, perhaps the two lines Rb and Rbβ are the most important for the purpose of discrimination. According to Bunsen, who was the discoverer of these two metals,* the spectrum projection of rubidium is so characteristic as to render the detection of the element possible when present to the extent of one five-hundredth of a milligram.

Referring to the comparison of atomic weights, Allen, Bunsen and Johnson fixed their number for cæsium at 132.0, but Godeffroy estimated it at 131.6. The actual atomic weight may be said to be above both of these estimations. A careful examination of *cæsium chloride*, CsCl, with a silver salt shows the real atomic weight to be nearer 133, and between this figure and 132.8. *Both Bunsen and Grandeau found* a number very close to the mean of 84.8 for rubidium (the latter obtaining his result from the sulphate), but the generally accepted atomic weight is a trifle higher, *i.e.*, 85.1.

To a certain extent, some discrimination may be effected from the more general properties of the salts. The oxides and hydroxides are so alike as to render the spectrum analysis—paying particular attention to wave-length—the most accurate method of recognition. The two normal sulphates greatly resemble one another; but in the case of rubidium the crystals are of the rhomboid order, while with cæsium the crystals are short and prismatic. It is the acid salt which resembles the normal rubidium salt. The two formulæ are Cs_2SO_4 and Rb_2SO_4.

The *combination of either of the metals* with the halogens produces some interesting compounds well worthy of deeper investigation. In most instances these haloids are very similar, and are perfectly analagous to the corresponding potassium salts. The two compounds, CsCl and RbCl, are simple in construction, but both cæsium *and rubidium unite far more readily* with the halogens to produce poly-haloids than does potassium. Of cæsium may be mentioned CsI_3, CsI_5, $CsBr_3$, $CsBr_5$, and $CsCl_4I$ (*iodated cæsium tetrachloride*). The rubidium poly-haloids are RbI_3, $RbBr_3$, $RbCl_2Br$ (*brominated rubidium dichloride*), $RbClBr_2$ (*dibrominated rubidium chloride*), $RbBr_2I$ (*dibrominated rubidium iodide*), RbClBrI (*iodo-brominated rubidium chloride*), and $RbCl_4I$ (*iodated rubidium tetrachloride*). The rubidium salts, in conjunction with numerous metallic chlorides, also form double salts of the $RbNO_3.FeCl_2$ type.

In the nitrates, an interesting comparison of solubilities forms some distinction between the two metals. Eleven parts of *cæsium nitrate*, $CsNO_3$, dissolve in one hundred parts of water at 3.35° C.; while *rubidium nitrate*, $RbNO_3$, presents a very wide difference, one hundred parts of water dissolving 79.9 parts of the nitrate at the same temperature. Other points on the same curve for the same volume of water are: 20.3 at 0° C. and 442 at 10° C.

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* Both cæsium and rubidium had been investigated before by numerous chemists, who mistook their natural compounds for *the analagous potassium compounds.*

BOOKS RECEIVED.

Modern Microscopy. M. I. Cross and Martin J. Cole. Pages X. + 315. 1922. Fifth Edition. Messrs. Baillière, Tindall, & Cox, 8, Henrietta Street, Covent Garden. Price 10s. 6d.

Dyes Classified by Intermediates. R. Norris Shreve, in collaboration with Warren N. Watson and A. R. Willis. Pages 631. 1st Edition, 1922. New York: The Chemical Catalog Company, Inc., 1, Madison Avenue. Price 10 dollars.

CHEMICAL NOTICES FROM FOREIGN SOURCES

THE TWO $\alpha\alpha$-$\beta\beta$-SUBSTITUTED PROPIOPHENONES AND THEIR DECOMPOSITION PRODUCTS WITH SODIUM AMIDE—*Mlle. Ramart and G. Albesco.*—The authors have prepared the substituted ketones of the type $(C_6H_5)_2$ CH - CR_2CO -C_6H_5 by condensing the mixed organo-magnesium compounds with the benzylidene acetophenones. When these ketones are alkylated with sodium amide they readily split up to give $(C_6H_5)_2$ CH-CR_2 $CONH_2$ and C_6H_6, and also $(C_6H_5)_2$ CH-CHR_2 and $C_6H_5CONH_2$, the two reactions occurring in about equal proportions.—(*Comptes Rendus,* CLXXIV, 1922, 1289.)

AUTO-OXIDATION OF ORGANIC COMPOUNDS —*Marcel Delépine.*—Some years ago the author discovered that many organic compounds containing sulphur are oxidised spontaneously in the air at the ordinary temperature with production of fumes and light. All these compounds contain sulphur linked by a double bond -S=C= or S=P≡. He now finds that although this auto-oxidation is spontaneous, only a very small quantity of sulphurous vapour is involved, and the reaction stops before any reversible equilibrium can be reached. The presence of fixed alkalis or ammonia enables the oxidation to proceed to its limit. It seems as if the compound containing sulphur were capable of arresting its own oxygenation, but only at a certain limit of concentration, below which the auto-oxidation is possible and spontaneous. Above this concentration which is certainly lower than the saturated vapour tension, the auto-oxidation is indefinitely arrested. It is possible that the process takes place explosively, and if this is the case the phenomenon recalls the phosphorescence of phosphorus.—(*Comptes Rendus,* CLXXIV., 1922, 1291.)

EXTRACTION AND PURIFICATION OF SCANDIUM FROM MADAGASCAR THORVEITITE—*Pierre Urbain and G. Urbain.*—Madagascar thorveitite is easily attacked when fused with soda and the silica contained in it is eliminated when the residue is taken up with water. The insoluble residue is then treated with sulphuric acid, and the solution of sulphates is precipitated with hydrofluoric acid. The fluorides of scandium and the rare earths are washed and then decomposed with sulphuric acid in excess. The scandium can be precipitated in a very pure state by means of potassium sulphate, after the sulphates have been transformed into nitrates. Ammonia never precipitates all the scandium from liquids containing it, but the precipitation of scandium phosphate is quantitative in an ammoniacal medium, provided that amonium carbonate is absent. The latter appears to dissolve all scandium precipitates, and the solutions obtained are decomposed by heat, hydroxycarbonates being usually precipitated. The yttric earths containing scandium which have been concentrated in the mother liquors of the precipitates of the double potassium sulphates are transformed by ammonia into hydroxides. These are finally treated with a slight excess of acetylacetone. Only a trace of scandium is found in the mother liquors and the rest of the earths is converted into the crystalline acetylacetonates. When these are treated with chloroform all the scandium is dissolved and a residue of yttric acetylacetonates is left. The final separation is effected by sublimation in vacuo at about 200°, the scandium compound only being volatile.—(*Comptes Rendus,* CLXXIV., 1922, 1310.)

THE SPECTRUM OF RADIUM EMANATION.

By R. E. NYSWANDER, S. C. LIND, AND R. B. MOORE.

(*Abstract from the Astrophysical Journal.*)

Spectrum of RaEm, λλ 3982 to 7450.—Two capillary discharge tubes were filled with 0.2 and 1 curie of carefully purified emanation, respectively, and both visual and photographic measurements were made with a 4-prism spectrometer. The relative intensities of the lines differed markedly, as a rule, from the previous observations of Watson and Royds and Rutherford; many strong lines of the 120 previously measured were not found, and yet of the 44 lines obtained, 9 are new lines. Changes of intensity with duration of the discharge were noticed, some lines decreasing, some increasing in strength, while the colour of the discharge changed from a bright glow to violet. λ 5483 and some other lines flashed out on reversing the current after a

thirty-minute run and then quickly disappeared.

Occlusion of RaEm in discharge tube.—After a discharge had passed through the glass capillary tube containing 0.2 curie for 5 hours, 35 per cent. of the emanation had been occluded, most of it in the platinum mirror surrounding the cathode. The other tube became quite hard after a four-hour run.

Modification of Duane's apparatus for purifying RaEm.—The copper wire used to remove oxygen and hydrogen is spirally wound on a silica tube and is heated indirectly by an electrically heated Pt wire passing through the tube, instead of directly by a current through the Cu wire. This arrangement requires less current and less attention.

The spectrum of radium emanation has been determined by Ramsay and Collie;[1] Cameron and Ramsay;[2] Rutherford and Royds;[3] Royds,[4] and Watson.[5] The observations of Ramsay and Collie were entirely visual and showed a bright spectrum which rapidly disappeared and was replaced by the secondary spectrum of hydrogen. The first photographs of the emanation spectrum were those of Cameron and Ramsay, whose results showed a strong resemblance to xenon;[6] hydrogen also made its appearance in the spectrum. Rutherford and Royds photographed the emanation lines with a single (glass) prism spectrograph, using the emanation from 130 mg. of radium. Hydrogen lines were also observed, but to separate these from the emanation lines a side tube atached to the spectrum tube was immersed in liquid air, and at the point of condensation of the emanation its lines disappeared, leaving those due to hydrogen. Royds repeated the work, using a concave grating of a dispersive power, of 16.8 A per millimeter, and was able to photograph about thirty-five of the more intense lines already obtained by Rutherford and Royds with good agreement and extended the observations further into the ultra-violet. Watson's investigation was undertaken with a view of accounting for the discrepancies between former observations and his own results; he employed both a prism spectrograph and a grating. His results are in very good agreement with those of Rutherford and Royds.

For the photographic work of the present experiments, a Browning spectrometer with a train of four prisms and photographic attachment was employed, at the University of Denver. The results extended from λ 3982 to λ 7449, being limited in the violet end of the spectrum by the opacity of the glass system. The spectrum of helium was used as a comparison standard. To avoid relative displacement of the two spectra on the plate, a lens was fixed in front of the collimator slit, and the images of the two sources were focused alternately on the slit. By means of a small shutter, adjoining portions of the slit could be illuminated separately. The wave-lengths of the emanation lines were computed by the aid of Hartmann's dispersion formula. The dispersion of the instrument is 13 A per millimeter at λ 4000, and 136 A at λ 7000. The total length of the spectrum between these limits is about 6.8 cm. All measurements of wave-lengths were made with a Gaertner comparator of 200 mm. range fitted with a screw of 1 mm. pitch. Individual measurements of a line as read on the comparator seldom differed by as much as 0.005 mm., which will give an estimate of the accuracy of the results. The wave-lengths recorded in the table were determined from six photographs, and where a line appeared on more than one plate the mean value is recorded. The more intense lines were found on each of the six photographs. Two types of dry plates were employed, the Standard Orthonon and the Wratten Panchromatic. In addition to the spectrograph, a Hilger constant-deviation spectrometer was arranged so that visual observations could be made simultaneously with the photographic.

The method of purification of the emanation was developed by Lind, and is a modification of Duane's apparatus. In addition to the process of purification as described in the note, the emanation was frozen down in liquid air for removal of the residual gases by pumping. After purification the gas was collected in small glass vacuum tubes of capillary bore with plati-

1 *Proceedings of the Royal Society*, A, 73. 470, 1904.
2 *Ibid.*, 81, 210, 1908.
3 *Philosophical Magazine* (6), 16, 313, 1908.
4 *Ibid.*, 17, 202, 1909.
5 *Proceedings of the Royal Society*, A, 83, 50, 1910.
6 *Ibid.*, A, [illegible]

at the ends. Before the liquid air was removed from the vacuum tube in which the emanation was condensed, the tube was sealed off and the photographic exposure was then started as soon as the tube could be adjusted in front of the slit of the spectrograph. The photographs were obtained almost entirely from two spectrum tubes. The first of these contained 208 millicuries of emanation. Two exposures of two and three hours' duration respectively were secured from this tube. It was then broken into small pieces along its length and each piece measured for occluded emanation. The total occlusion in the tube was 35.1 per cent., this being the largest amount of occluded gas measured in any case. This occluded emanation was found to be confined largely to the platinum mirror surrounding the negative electrode. The colour of the tube changed from the characteristic bright glow at the beginning of the exposure to a violet colour after about one hour's excitation. The second vacuum tube contained approximately 1000 millicuries of radium emanation. Four photographs were secured from this tube with almost continuous excitation for nearly four hours, when the tube became quite hard. After the conclusion of our photographic work with this tube, unfortunately it cracked, leaving us without exact measurements of both occlusion and total quantity of emanation. Small, fused, silica, electrodeless, vacuum tubes of capillary size were also tried. They were excited inductively by means of copper coverings deposited electrolytically on platinum coatings on the ends of the tubes. No effect on the photographic plate could be detected after more than one hour's exposure with these tubes.

It was not possible to photograph the entire spectrum on the plate at one exposure. Accordingly the plates were adjusted to receive the violet and red ends of the spectrum alternately. The greater portion of the spectrum appeared on each plate, leaving only the extreme ends to be photographed alternately.

In the table of wave-lengths there have also been recorded, for comparison, along with our results the values determined by Watson and by Rutherford and Royds, since the results of these observers are most trustworthy. Wherever there is coincidence in the lines, the results of the present observations are in excellent agreement with those of the other observers; however, they have recorded many lines which do not appear on our plates. For example, the region between λ 6361 to λ 4732 contains a large number of lines, especially as recorded by Watson, yet our plates show only a few lines in this region and none that could be considered to coincide. It is noteworthy that lines of such great intensity as λ 5582 and λ 5084 should produce no trace on our photographs, nor were these lines observed visually by us.

Among the lines which we observed visually there were several which did not appear on the photographic plates; two of these were broad, faint lines at λ 5058 and λ 4826 respectively, and also a line of low intensity at λ 4735. During the visual observations it was noticed that upon reversal of the current through the induction coil certain lines would appear suddenly and then fade away rapidly. This effect could be produced only after operating the coil as much as 30 minutes in one direction and then reversing the current. The most prominent of these was λ 5483, which appeared very brightly at the moment of reversing the current, but after a few minutes became invisible. It could not be reproduced by later reversals of the current. Other lines appeared brightly at the instant of reversal, but vanished before their wave-lengths could be measured.

Watson has called attention to the differences observed in the intensities of emanation lines; he has also denoted the relative degree of persistence of certain lines in the spectrum. The results of the present experiments have shown that the lines of greatest intensity are the most persistent, and that the intensities of these strong lines change very little on successive plates obtained from the same tube. The group of faint lines between λ 4463 and λ 4492 with one exception were recorded only on the first plate of one tube. On the other hand, there are a number of lines which seem to develop as the time of excitation of the tube advances. For example, the line λ 4721.2 has an intensity of 1 on the first plate, 4 on the second plate, and 5 on the third plate. The line λ 4625.3 does not appear in the first exposure of either tube,

but appears on the second and third plates with increasing intensity. The line λ 4644.0 also belongs to this class. The lines λ 4577, λ 4460, and λ 4307, which Watson has observed to be fugitive lines, for us are quite persistent.

The emanation for these experiments was derived from a supply of radium belonging to the United States Bureau of Mines' Experimental Station at Golden, Colorado.

PROCEEDINGS AND NOTICES OF SOCIETIES.

ROYAL SOCIETY.

LIST OF PAPERS READ JUNE 22, 1922.

G. I. Taylor, F.R.S.: The Motion of a Sphere in a Rotating Liquid.

Prof. T. R. Merton, F.R.S., and D. N. Harrison: On Errors arising in the Measurement of Unsymmetrical Spectrum Lines.

E. F Armstrong, D.Sc., F.R.S., and T. P. Hilditch, D.Sc.: A Study of Catalytic Actions at Solid Surfaces. Part VIII.: The Action of Sodium Carbonate in promoting the Hydrogenation of Phenol. Part IX.: The Action of Copper in Promoting the Activity of Nickel Catalyst.

E. A. Milne: Radiative Equilibrium: The Relation between the Spectral Energy Curve of a Star and the Law of Darkening *of the Disc towards the Limb, with special* Reference to the Effects of Scattering and the Solar Spectrum. Communicated by Prof. H. F. Newall, F.R.S.

C. W. Hinshelwood: On the Structure and Chemical Activity of Copper Films and the Colour Changes accompanying their Oxidation. Communicated by Prof. J. W. Nicholson, F.R.S.

R. C. Ray: Heat of Crystallisation of Quartz. Communicated by Dr. M. W. Travers, F.R.S.

ORDINARY MEETING—JUNE 1, 1922.

Sir Charles Sherrington, President, in the Chair.

The Croonian Lecture was delivered by Prof. T. H. Morgan, Columbia University, on "The Mechanism of Heredity"; the summary here printed having been supplied by the Lecturer for use at the meeting:—

The changes that take place when the germ-cells ripen are known to be of such a kind that, granting the hereditary elements are carried by the chromosomes, these changes may be made to serve as a mechanism that furnishes an explanation of the principles of heredity discovered by Mendel.

If the criticism be made that these facts only show a parallelism between the chromosomes and inheritance of characters, then the following evidence bears very directly on the issue.

In the course of the ripening of the germ-cells ,irregularities occur at times in the distribution of the chromosomes. These irregularities can be followed in successive generations, and the departures from the ordinary course of inheritance, that are there shown, are found to be *exactly* related to the new distributions of the chromosomes. Without a detailed account of this evidence it is not possible to do more than to state that the facts furnish most convincing testimony that the Mendelian characters are carried by the chromosomes.

Not only is there evidence that the chromosomes are the bearers of the hereditary elements, but owing to a phenomenon known as "crossing-over" it is possible to determine that the hereditary elements lie in a single line in each chromosome. It is even possible to form a rough estimate of the upper limits of size of these elements, although at the present time such estimates are necessarily very crude, and are interesting only as the first attempt to determine the size of the "gene."

THURSDAY, JUNE 15, 1922, AT 4.30 P.M.

Papers read:—

H. M. Evans, M.D.: The Defensive Spines of Fishes, Living and Fossil, and the Glandular Construction in connection therewith, and Observations on the Nature of Fish Venoms. Communicated by Dr H. H. Dale, F.R.S.

D. W. Cutler, L. M. Crump, and H Sandon: A Quantitative Investigation of the Bacterial and Protozoan Population of the Soil: with an Account of the Protozoan Fauna. Communicated by Dr. E. J. Russell, F.R.S.

D. W. Devanesen: The Development of the Calcareous Parts of the Lantern of Aristotle in *Echinus miliaris*. Communicated by Prof. E. W. MacBride, F.R.S.

A. Lipschütz, M.D., C. Wagner, I Tamm, and F. Bormann: Further Experimental Investigations on the Hypertrophy of the Sexual Glands. Communicated by Dr. F. R. A. Marshall, F.R.S.

ROYAL INSTITUTION.

A General Meeting of the members of the Royal Institution was held on the 12th June, *Sir James Crichton-Browne*, Treasurer and Vice-President, in the chair. Mr. H. Cooke, Mr. E. Davies, Miss Joan Evans and Mrs. A. Jacobs-Larkcom, were elected members. The Chairman reported the death of *Ernest Solvay*, an Honorary Member of the Institution, and a resolution of condolence with the relatives was passed.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society, held on Thursday, 8th June, Sir Frank Dyson, F.R.S., President, in the chair, the following papers were read and discussed:—

"Angle Comparators of High Precision for the Goniometry of Prisms," by J. Guild, A.R.C.Sc., F.Inst.P., F.R.A.S.

This paper describes applications of the method of substitution to goniometric measurements of high precision. A simple arrangement is described with which measurements accurate to within one or two seconds can readily be made, and a more elaborate arrangement with which an accuracy of about 0.1 second may be attained. The latter embodies a method which appears to be new, of obtaining very minute variations in the direction of a beam of light emerging from a collimator by placing near the focal plane of the latter a "variable prism" of simple design and construction.

"The Changes in Aberrations when the Object and Stop are moved," by T. Smith, M.A., F.Inst.P.

If the aberrations of any centred optical system are known both for an object which intersects all rays transmitted by the system and also for the centre of the effective stop, the position in the image space of the emergent portion of a given incident ray is known, and the aberrations in the image of any other object for any stop position can be expressed in terms of those for the first object. The investigation aims to express the relations in the second case in terms of those present in the first when the objects are planes normal to the axis of symmetry whatever the order of the aberration may be.

"The Classification of Optical Instruments," by T. Smith, M.A., F.Inst.P.

Exception is taken to the classification of optical instruments by the signs of their powers, and an alternative division comprising five classes is proposed, based upon the separation of the four Gaussian constants into two groups according to their signs. This classification cannot be modified by the addition to the system of inverting prisms and the like, and the properties usually associated with the sign of the lens in reality depend upon its class according to the new system. Each class may have systems of positive or of negative power.

"Note on Achromatism with one Glass," by T. Smith, M.A., F.Inst.P., and L. M. Gillman, B.Sc.

Systems composed of thin lenses of the same kind of glass and achromatised by selecting suitable positions for the components are members of the class (AD) (BC), so that if the object is real the image is virtual. Apochromatic systems constructed from normal achromatic lenses belong to the same class. The outstanding aberrations for systems constructed of a single glass but belonging to other classes are of considerable magnitude.

"An improved Subjective Test for Astigmatism," by Herbert S. Ryland.

The present test has been designed to obviate certain difficulties which patients experience when the usual test card is used. It consists of an opaque disc perforated along two diameters at right angles with a series of square apertures. These apertures and the distances between them subtend angles of 1′ at the usual testing distance. The plate is illuminated by diffused light from the rear.

ROYAL MICROSCOPICAL SOCIETY,

20, HANOVER SQUARE, LONDON, W.1.

A meeting of the Society was held in the Lecture Hall at the above address on Wednesday, 21st June, 1922, at 7.30 for 8 p.m., when the following papers were read:—

Mr. A. Chaston Chapman, F.I.C., F.R.S., F.R.M.S. "The Use of the Microscope in the Brewing Industry."

Mr. A. Brooker Klugh. "The Plunger-Pipette."

Mr. E. A. Spaul, B.Sc. "The Gametogeneis of *Nepa cinerea* (Water Scorpion)."

Mr. James Strachan, F.Inst.P., F.R.M.S. "The Microscope in Paper Making."

The names of the following gentlemen will be submitted to the ballot for election as Ordinary Fellows of the Society: Mr. J.

Nelson Arnold, F.P.C., M.S.P., Mr. Godfrey Hecht, Mr. James W. Low, B.Sc.

The Annual Conversazione of the Society will be held at the Examination Hall, 8, Queen Square, Bloomsbury, W.C.1, on Wednesday, 11th October, 1922, from 7.30 to 10.30 p.m. Offers of assistance from Fellows of the Society who can bring exhibits will be greatly appreciated by the Hon. Secretaries.

THE INSTITUTE OF PHYSICS.

LECTURES ON "PHYSICS IN INDUSTRY."

No. II.: "Physics in Engineering Practice," by Sir James Alfred Ewing, F.R.S.

Members of the Faraday Society are invited to attend the above lecture, which will be given on Tuesday, July 4th, 1922, at 5.30 p.m., in the Hall of the Institution of Electrical Engineers, Victoria Embankment, W.C.2.

Sir Charles Parsons, K.C.B., F.R.S., has kindly consented to preside.

THE FARADAY SOCIETY.

June 12th, 1922.

Dates of Ordinary Meetings of the Society.

The Council has decided that in future the Ordinary Meetings of the Society shall be held on fixed dates. There will always be Ordinary Meetings on the third Monday in February, May, October and December. General discussions and additional meetings may be held on other dates, but so far as possible the third Monday will always be chosen.

PUBLICATION OF TRANSACTIONS.

In future the transactions will be published four times annually, and will appear on the 1st of February, May, October, and December.

It is hoped that the holding of regular Ordinary Meetings and the more regular publication of the transactions will be helpful to members who desire to present original communications to the Society. The Council invites from members such communications in all branches of pure and applied physical chemistry, including electrochemistry and electrometallurgy.

ANNUAL GENERAL MEETING.

Notice is given that the Annual General Meeting will be held on Monday, November 20th. The nominations for officers and council will be announced in due course.

In future years the Annual General Meeting will be held in May, and the officers and council elected at that meeting will come into office the following October 1st.

FORTHCOMING MEETINGS.

An Ordinary Meeting will be held on Monday, June 26th.

On Monday, October 16th, there will be held a general discussion on "The Generation and Utilisation of Cold." There will be an afternoon and evening session, and the meeting will be held at the Institution of Electrical Engineers. Fuller particulars will be announced later.

Later in the year there will probably be a joint discussion with the Sheffield Section of the Institute of Metals on "The Corrosion of Non-ferrous Alloys."

Early in 1923 the Society will hold a general discussion on "The Physical Chemistry of the Photographic Plate."

ORDINARY MEETING, MONDAY, JUNE 26TH, 1922, AT 8 P.M., AT THE CHEMICAL SOCIETY, BURLINGTON HOUSE, PICCADILLY, W.1.

Papers to be read:—

Professor Alfred W. Porter, F.R.S., President: "The Law of Distribution of Particles in Colloidal Suspensions with special reference to Perrin's Investigation."

W. R. Cooper: "The Electrochemical Effects Produced by Superimposing Alternating Currents upon Direct Currents."

Professor T. M. Lowry and E. E. Walker: "Properties of Powders, Part II.: Expansion and Shrinkage during Caking of Potassium Carbonate."

Professor T. M. Lowry and L. P. McHatton: "Properties of Powders, Part III.: The Powdering of Minerals by Decrepitation."

Dr. A. M. Williams: "Two Properties of Powders."

Dr. J. L. Haughton and G. Winifred Ford: "A note on the Systems in which Metals Crystallise."

A. J. Kieran: "The Electrical Conductivity of Hydrochloric Acid and Potassium Chloride in presence of Sucrose."

ROYAL SOCIETY OF ARTS.

June 23rd, at 4.30 p.m.: F. W. Woods, C.I.E., "Irrigation Enterprise in India."

NOTES ON BOOKS.

The Instanter Interest and Discount Tables, published by Messrs. Bowman & Murdock, 99, Shoe Lane, E.C.4. Price 1s.

This compilation marks a distinct advance on any tables of the kind hitherto published. By a simple and ingenious arrangement, the interest of amounts from 1d. to £1,000 can be found instantly, at rates varying from ⅛th of 1 per cent. to 95 per cent.

A Textbook of Organic Chemistry, by J. S. CHAMBERLAIN, PH.D. Pp. XLIII. + 959. London: George Routledge and Sons, Ltd., 1921. Price 16s. net.

The author has added another textbook on organic chemistry to the many already existing. It has few features of striking originality, and possesses the usual characteristics of this type of book.

Aliphatic and aromatic bodies are systematically discussed, and the fundamentals of this branch of science are presented in a manner eminently suitable for students.

A brief account of the separation, purification and analysis and molecular weight determinations is given in the form of an appendix, instead of early in the text as is customary. This seems a distinct advantage. No references are given to original papers, but this is unessential in a book of this type.

Very few errors have been noticed, but terephthalic and mandelic acids are repeatedly spelt in an unusual way.

As the book is quite up-to-date and published at a fairly reasonable price, it should commend itself to lecturers and their students. J.G.F.D.

Some Physico-Chemical Themes, by A. W. STEWART, D.Sc. Pp. XII. + 419 + 5 plates. London: Longmans, Green and Co., 1922. Price 21s. net.

Professor Stewart has written a very readable volume on a number of interesting physico-chemical topics.

Some of the chapters have evidently been adapted from an early edition of his "Recent Advances in Physical and Inorganic Chemistry," by incorporating the results of later investigations.

A survey of the whole field of Physical Chemistry has not been attempted, the author having confined himself to a discussion of certain topics.

Critical readers may regret the omission of subjects in which they are interested, but in general, the matter has been well chosen.

From a consideration of double salts, the author passes on to a good description of Van 't Hoff's researches on the Stassfurt Salt Deposits. The theory of indicators, non-aqueous ionising media, colloids, adsorption, catalysis, and the development of the Periodic Law are among the many subjects considered.

It is very regrettable that the author loses no opportunity of attacking Ostwald. Whatever subsequent research may prove, it is beyond dispute that Ostwald has contributed considerably to the advancement of Science, both by his own researches and by his inspiration of others. His belief in the fundamental importance of energy and his preference for this concept in place of that of matter, has recently received much support from Einstein's theory of Relativity.

Professor Stewart's books on "Recent Advances in Chemical Science" appeal especially to students, both prior and after they have graduated. His present volume will also be very popular among them, and should be widely read by chemists generally. J.G.F.D.

Power Alcohol: Its Production and Utilisation. G. W. MONIER WILLIAMS, O.B.E., M.C., M.A., Ph.D. Pp. XII. + 323. Henry Frowde and Hodder & Stoughton, London. Price 21s. net.

In these days of increasing oil consumption a book dealing with the prospects of

any alternative or additional source of supply is welcome.

The first chapter is devoted to statistics on the production and consumption of motor fuel. The next chapters are devoted to a consideration of the plant as a source of alcohol, together with an account of the various systems of fermentation and distillation, and the principles underlying these. This is followed by an important chapter on the economics of alcohol production from crops in which the probable yields and cost of production of alcohol from various plants are discussed, from which it appears as if we cannot look for any great cheapening in the cost of motor fuel due to the use of alcohol.

The question of the production of alcohol from cellulose materials is then thoroughly considered, and also the synthetic production from ethylene and acetylene.

An account is then given of the various methods of excise supervision and denaturation employed in various countries.

The next chapter is devoted to the principles underlying the internal combustion engine, and an account is given of the important work of Richards, while the final chapters deal with a consideration of the properties of alcohol fuels, both from a chemical and physical standpoint, and also from the practical results of engine tests.

This book deals with the alcohol problem in a very well-balanced manner, and can be thoroughly recommended.

Full references to original papers, etc., are given, and these show the large amount of work which has been considered and is now made more available for practical use.

A.T.G.

Town Gas Manufacture, by RALPH STALEY, M.C. Pp. XII. + 108. London: Sir Isaac Pitman &Sons, Ltd. Price 2s. 6d. net.

This book commences with a chapter on coal and its handling, and then a description is given of the various systems of carbonisation, and also of water-gas and complete gasification processes. The course of the gas is then followed through the works, and chapters are devoted to the exhauster, wet and dry purification, naphthalene blockages, gas measurement and storage, and finally there is a chapter on the manufacture of sulphate of ammonia. In each chapter illustrations are given of most of the types of plant described, and in some cases useful notes as to yields, etc., are added.

The book is written in a non-technical manner, and is very suitable for those who wish to obtain a general idea of the processes of town gas manufacture and purification.

A.T.G.

PHOSPHORUS IN HEMATITE IRON,

CONTAINING UP TO ABOUT 0.2% PHOSPHORUS, 0.5% TITANIUM, AND 0.15% ARSENIC.

Short modification of the "Concentration" method (*Proc. Clev. Inst.* Eng., Feb., 1920, and *Chemical News*, May 7th, 1920) for Works Purposes where the Greatest Speed consistent with a high degree of accuracy is paramount.

The principle of the method is identical with that of the "Concentration" method referred to above, the accuracy of which has been thoroughly established not only by the author, but by a number of other chemists in Great Britain. In outline it consists of precipitating the phosphorus in the presence of graphite, etc., with a large excess of nitromolybdate, in a very concentrated solution, in order to overcome the retarding influence of titanium; then re-dissolving this precipitate, which is more or less contaminated with arsenic, silica, etc., through the filter and purifying it by re-precipitation.

DETAILS OF MODIFIED METHOD.

To 2 grams of fine drillings in a covered 400 cc. tall form beaker having a graduation mark at 50 cc., add gradually a mixture of just 15 cc. nitric acid (s.g. 1.42) diluted to 30 cc. with water. Simmer gently, with the cover on, so as to avoid unnecessary loss by evaporation. Most samples dissolve without difficulty in 15-30 minutes, allowing the silicon to pass into solution and leaving an almost silica-free graphitic residue. In all but unusually silicious irons, by proceeding at once with the analysis, the first precipitation of the phospho-molybdate may be readily effected without any appreciable amount of gelatinous silicic acid separating out; if, however, large gelatinous clots are observed, or if it is desired to hasten the dissolving, add with aluminium tongs 1 compressed reagent containing NH_4HF 1 gram, agitate the beaker for a few seconds till the tablet has disintegrated, then boil the contents of the

covered beaker *gently* a few minutes till the silicious clots, often noticeable at first, mostly disapear.

Without removing the graphite, proceed at once to add with the aid of aluminium tongs 1 compressed reagent (pot. permang. 0.25 grms.) and simmer gently for about two minutes to completely convert the phosphorus to orthophosphate.

Add two compressed reagents containing in all, am. oxal. 0.6 grms., ammon nitrate 7.7 grms., and am. chloride 1.5 grms. These dissolve the manganese oxides and at the same time introduce the necessary ammonium salts for the precipitation of the phosphorus.

Simmer about 2 minutes after the solution has cleared; add just 12 cc. conc. nitric acid (s.g. 1.42) by pouring down the sides whilst rotating the beaker, and as soon as the solution boils, remove the cover without rinsing it, lift the beaker off the heater and precipitate the phosphorus—contaminated with more or less arsenic, silica, etc. —by pouring into the middle of it, whilst swirling it, 20 cc. of conc. ammonium molybdate solution (150 grms. per litre, faintly ammoniacal).

Agitate vigorously for a full two minutes (timed), and then allow the liquid to stand at atmospheric temperature for not less than 5 minutes. The phosphorus will now be completely precipitated, even if there is as little as 0.02 per cent., with as much as 0.5 per cent. titanium.

Filter through a small paper pulp filter, preferably without using suction, prepared as previously described by the author. Rinse in and wash four or five times, using about 10 cc. liquid each time—*i.e.*, just sufficient to remove all but occluded iron salts—with nitric acid water [20 cc. (s.g. 1.42) per litre of water]. As usual, don't wash any more than is just necessary.

Place a small 100 cc. beaker under the funnel, and pour on to the pulp 10 cc. of nearly boiling citric* acid solution (25 grams per litre). When this has just percolated through, pour on 5 cc. cold diluted ammonia solution [15 cc. conc. ammonia (s.g. 0.880) diluted to 100 cc. with cold distilled water] and allow to drain into the same beaker.

Return the combined filtrate through the pulp, receiving it in the original 400 cc. beaker having a graduation mark at 50 cc. Rinse the 100 cc. beaker with fine nozzle and wash the pulp with boiling water 4 or 5 times, using a broad nozzle so as to add the minimum wash water (8-10 cc.) to completely cover the pad of pulp.

If these instructions are observed, the whole of the phosphorus will be in the clear filtrate, measuring only about 50 cc., and the graphite silica, etc., will remain on the pulp.

If necessary, evaporate the clear filtrate down to the 50 cc. mark on the beaker; remove the beaker from the source of heat, and to the 50 cc. of liquid at about 100 deg. C. add 50 cc. of cold (12°-16° C.) ferric-nitro-molybdate reagent and re-precipitate the phosphorus—free from arsenic, silica, etc.—at about 60 deg. C., agitating continuously for 2 full minutes and allowing to stand 5 minutes at atmospheric temperature. If the arsenic is likely to be above 0.05 per cent. this period of standing should not be exceeded.

Filter through pulp, wash with 0.1 per cent. pot. nitrate solution, and titrate with N/6.74 NaOO and HNO_3 exactly as described formerly by the author.

Whilst the instructions throughout the method should be carefully followed, there is no difficulty in keeping within the allowable limits as to volumes, temperatures, etc.

Ferric-nitro-molybdate.—This solution is made up according to the instructions furnished with the original "Concentration" Method described in the *Proc. Clev. Inst. Eng.*, Feb., 1920, and on page 220 of *Chemical News*, May 7th, 1920.

A single test may be made within an hour. Although this is only 10 or 15 minutes shorter than the "Concentration" Method formerly described, there is a much greater proportionate saving when doing several tests together, as there are appreciably fewer operations, and not so much continuous attention is required.

The use of compressed reagents—which are being increasingly employed to facilitate analysis—is found particularly helpful in

* The object of adding the hot citric acid first is to saturate the precipitate with it, so that on adding the ammonia to dissolve the phospho-molybdate, any traces of iron occluded with the precipitate are converted into soluble ferric citrate, thus ensuring complete solution of the phosphorus and avoiding the possibility of any trace of it being precipitated as ferric phosphate, which would remain on the filter and thereby make the results low.

this method in which success is largely dependent on readily maintaining very concentrated solutions.

Careful experiments have proved that this method is comparable in accuracy with the best known and much more elaborate methods for phosphorus in titaniferous or arsenical hematite iron, and every trial test made by it on standard samples has been within 0.002 per cent. of the standard figure. A few of the results are given below:

	% Ti	% As.	% P. Std figure.		% P. found.
Description of sample.	(total).	0.04	0.040		0.0495
B.C.Std Iron "A"	0.05	0.03	0.026		0.0275
B.C.Std Iron "B"	0.11	?	0.058		0.059
Sample East Coast	0.42	0.01	0.049		0.050
B.C.Std iron "A" + 0.35% Ti.	0.40	?	0.030		0.030
Sample W. Coast + 0.13% Ti.	0.40	0.14	0.049		0.050
B.C.Std Iron "A" + 0.10% As.	0.05	0.13	0.026		0.028
B.C.S. Iron "B" 0.10% As.	0.11	?	0.043	Fluoride	0.043
4.2% silicon steel	none	0.03	0.026	compressed	0.026 &
B.C. Std iron "B"	0.11			reagent added	0.0255

N. D. RIDSDALE.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

14408—Coke & Gas Ovens, Ltd.—Apparatus for dehydrating tar. May 22.

14537—Farbwerke vorm. Meister Lucius & Bruning.—Manufacture of sulphonic acids of the 2:3-oxynaphthoic acid artlides. May 23.

14592—Ferguson, J. B. P.—Manufacture of calcium lactate and lactic acid from fermentable sugar solutions. May 24.

14655—Soc. Chimiquedes Usines du Rhone.—Process for preparation of basic salicylate of alumina. May 24.

14768—Techno Chemical Laboratories, Ltd.—Rotatable heat-transmitting appliances. May 25.

Specifications Published This Week.

156,800—Norsk Hydro - Electrisk Kvaelstofaktieselskab.—Process of converting nitrous gases into concentrated nitric acid.

156,799—Norsk Hydro-Elektrisk Kvaelstofaktielskab.—Manufacture of concentrated nitrous gases.

157,750—Lehmann-Metall Ges.—Process for the manufacture of pieces of tungsten or molybdenum carbide of any desired size.

160,759—Amour Fertilizer Works.—Production of aluminium chloride.

179,723—Hansford, J. B.—Apparatus for drying sulphate of ammonia and other chemical salts.

179,753—Lewcock, W. — Production of aminophenols or aromatic amino-acids.

Abstract Published This Week.

Ferrous Sulphate; Hydrochloric Acid.—Patent No. 177,444.—Messrs. E. V. Chambers, of the Manse, and T. C. Hammond, of Hopewell, both in Lightcliffe, have obtained a patent for a process of treating waste ferrous chloride liquors by heating with sulphuric acid, to obtain ferrous sulphate. The hydrogen chloride and steam evolved being condensed. The apparatus comprises storage tanks in which the filtered liquors are treated with the required amount of sulphuric acid, and from which they are pumped to an overhead tank. Thence the liquors pass to a series of basins arranged in cascade form. This cascade is enclosed, and is heated by a furnace at its lower end. The fumes evolved from the heated liquors are condensed and hydrochloric acid is obtained in the receiver. A scrubbing tower filled with coke forms part of the condensation apparatus, and any fumes not condensed therein are drawn off through the chimney stack of the furnace. The liquors discharged from the cascade contain ferrous sulphate, which is allowed to crystallise in the tanks. The mother liquor, collected in the tank, is pumped back to one of the storage tanks to be re-treated.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3246

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

ANNUAL CONFERENCE, 1922.

ADDRESS BY THE PRESIDENT (MR. J. PALEY YORKE).

(*Continued from Last Week.*)

Technical education is not outside the boundaries of this fair country which I have called a good general education. There are some who would have us believe that it is, and who would be stricken with horror at the suggestion that a Junior Technical School might produce boys whose general education could be compared favourably with that of boys of equal age in Secondary Schools.

THE INDUSTRY OF THE TECHNICAL STUDENT.

In urging that Technical Education has a right to be considered I would ask for careful investigation of the old idea that anything which approaches the region of usefulness cannot possibly be of any educational value. It was once a golden rule that educational subjects, to be educational, should be uninteresting, difficult, and useless. Modern teachers recognise that the first essential is the stimulation of interest.

Look inside our Technical Institutions and see whether there is interest or not. In them there is sterner work and less opportunity for recreation—unhappily—than in any university college. The student is the keenest of all students—partly, no doubt, because he feels that his work is shot through with significance, and that he is not doing it merely because it is the proper thing for people in his set to do. It is said often that the attitude of the average undergraduate at college is summed up by the slogan, "We are here because we're here." That is probably a libel on the average undergraduate: it could never be applied to the student in the Technical Institute. There you will find application and energy which would stagger the imagination of the slothful. Above all do you find it in the evening classes, where men diligently pursue knowledge night after night for years on end, handicapped unmercifully by physical tiredness after the day's work, and in too many cases by the unsoundness of their fundamental education.

These are men who fill us with admiration, command our deepest respect, and who keep alive in us that enthusiasm without which no man can ever hope to teach or to inspire his students.

The cynic and the superior person will say at once that the earnestness of these students is measured by their desire to earn more money! But is it not really the desire to obtain the means for living a wider and fuller life? Would the cynic deny him that? Does the cynic's position in life depend in any way upon his education, and is he prepared to give up all his bodily comforts and take pleasure only in his cultural superiority? Let us be fair to the technical student of the evening classes, and let us realise that whatever may be the primary instinct which bids him to seek knowledge the net result will be the gaining of knowledge, and with the gain an increased breadth of vision and a greater sense of responsibility to himself and his fellow men.

It is one of our regrets that so few people know exactly what our Technical Institutions are doing. Even amongst the social workers there are very few who have any real idea of what goes on inside their doors. Members of education committees and even members of the advisory committees of institutions are to be numbered amongst the great majority who have no real knowledge of what is being done—and especially of what is being done in the evening classes.

EVENING CLASSES.

Suggestions are being made that many evening classes should be shut down in the interests of economy. We have no desire to bolster up any classes for which there is no response and in which no work of importance is carried on, but we do hope that the greatest care will be exercised in deciding what shall be abandoned and what shall be retained. We would particularly point out the danger which would result if the purely quantitative method of estimating the importance of all classes be adopted. There is generally a tendency on the part of education authorities to declare that unless the entries for a class reach a certain number the class should not be opened. On the surface this seems reasonable enough: my

complaint is that the same number is taken as the standard of measurement for all classes, whether very elementary or very advanced. In the same way classes are are closed down during a session should the attendance fall to the level of this certain number. Again the idea is quite reasonable, but I do contend that there should be no common denominator, and that account should be taken both of the subject of the class and the stage or year of the class. Surely a class of N students attending a fourth or fifth year course of a subject is of greater importance and national value than N students in their first year course! These advanced students have passed through the testing fires and have attained the zest of disciples. Through them the teacher might, and in all probability would, influence ultimately more people than the teacher who measures his beginners by the hundred. Higher classes must necessarily be smaller than elementary classes: in each successive year the sifting mesh becomes finer and finer. After so much sifting and sorting are we going to throw away the product of our labonrs? This is a point over which the Association must keep a close watch *in the interests of economy.*

THE BURNHAM REPORT.

I hope that at a professional conference your President may make reference to matters of common interest to the State and to the profession without bringing abuse upon his head and without laying the conference open to the charge that it is only concerned with the self-interest of its members. It was not possible at the last conference for any reference to be made to the report of the Burnham Committee for technical, etc., schools. The recommendations of that committee are now so well known that it is hardly necessary for me to say anything about them at this conference. There was much to cause disappointment to technical teachers. Although we were assured that we should not be prejudiced (compared with Primary and Secondary Teachers) because of the fact that our report had to be taken third in order, yet we were penalised—not deliberately perhaps (except in the matter of the date of operation) but by the circumstances of the time when our case was being considered. However, that is past history. The report was drawn up and agreed to, and we welcomed it in that it was a scheme on a national basis agreed to by representatives of the local Education Authorities on the one hand and by the representatives of the teachers concerned in the report on the other hand, and approved by the Board of Education on behalf of the national government. The report represents a result of collective bargaining: and it represents a distinct advance in the relationship between the local Education Authorities, the teachers, and the national authority, and it should bring about—and personally I feel sure that it will bring about—better mutual understanding and appreciation.

But it is a matter of very grave concern to us that certain Education Authorities have so far repudiated the agreement and have refused to give full effect to the recommendations of the Burnham reports. To the average British mind the recommendations of a report of that kind—an agreement between the parties concerned—are more binding than any Act of Parliament on the Statute book. Thus the spectacle of any public body repudiating an agreement and refusing to carry it into effect is one which must cause alarm to every thinking man and woman who has so far regarded the moral integrity of British public bodies as being beyond reproach.

What an example to show at an epoch in history when man is striving to come to a better and freer understanding of his fellow man and when the principles of collective bargaining and round-tahle Conferences are heing urged in place of the disastrous conflicts of the past as being more civilised and more humane.

Some local authorities have put the Burnham recommendations for primary and secondary teachers into operation and have then refused to honour the technical agreement! This is even more incomprehensible than wholesale repudiation, and argues a lack of appreciation of the fundamental principles of equity and fair-play and a lack of understanding of British psychology. The electorate is hlamed: but the electorate has not been asked for its opinion on facts.

We would ask those local education authorities who are not honouring the agreement what sort of a reputation they will establish for themselves, and whether they think that their action is likely to attract into their area any but those who cannot find employment elsewhere or to retain

teachers in their employment for a day longer than they are compelled to remain. What guarantee can they offer for the sanctity of agreements?

Appreciation of Non-Teacher Educationists' Work.

That is all I propose to say about the Burnham report in this address except to express my appreciation of the labours of the members of the committee. Particularly would I like to express my very keen appreciation of the labours of the non-teacher members of the committee. Lord Burnham was the perfect chairman, and the hours and hours of service which he gave to us make us his debtors for all time. And when I say "us," I mean local education authorities as well as teachers. I would also ask this conference to recollect that the representatives of local education authorities were for the most part business men and that the service they were rendering was proof of their interest in education. That service was rendered in hours snatched from their own business interests or in hours which might have been leisure hours; and it was rendered without any ulterior motives. Whilst I do not suggest that I endorse all their views or approve all their recommendations, I do appreciate their labours in the common cause, and would ask this conference to endorse that appreciation.

Whilst I am sounding this note I think that greater recognition might be given to the labours of Education Committees and Advisory Committees up and down the country. They are composed of hard-working public-spirited and eminently desirable men and women, and the country owes them a far greater debt of gratitude than it has knowledge of. The service which they render on education committees make them unpopular with the Borough and County Councils, and almost invariably subjects them to unjust accusations. Education committees themselves are not local authorities—but they are too often regarded as such when blame is being apportioned. I recognise their difficulties and appreciate their work, and whilst commending their courage generally I would urge that they should have more. And if I could beg an additional few hours of their service during the year—I know that I am asking for much—I would urge some visits to the Technical Institutions.

Finally I would urge that they should express their real convictions, and not seek refuge behind the possible opposition of a council or the alleged opposition of an electorate before which the facts may never be presented.

The Pensions Proposals.

Amongst the Government's proposals for reduction in the Education estimates is that of making the pension scheme for teachers contributory. Again I hope that I may be allowed to make some reference to the proposal because again it is a matter between the State on the one hand and ourselves on the other, and a remarkable principle is going to be introduced if no profession may criticise a State proposal without bringing down upon its head the charge of selfishness. The great point which the Government made was that the scale of salaries were agreed upon, and that to alter this would be a breach of faith. But, they argue, there would be no breach of faith in converting a pension scheme which was inaugurated as non-contributory and passed by Parliament as non-contributory into a contributory scheme. Our contention is that such would be a breach of faith and would in effect be equivalent to a direct cut in salaries. It would be a breach of faith because the salary scale agreed upon duly took the pension scheme into account, and had the Burnham Committee been told that there was any possibility of the pension scheme being altered so materially there would have been a corresponding alteration in the agreed scales.

Further, it is difficult to see upon what principle of equity it is proposed to levy a tax on teachers' pensions whilst the pensions of other national servants are to remain on their original basis. The principle of relativity is not confined to the movement of planets relatively to one another. There are very few absolute standards of measurement. Comparison is the usual basis of measurement, and whilst it may be odious it is also human and even necessary.

It is also difficult to see how the Government conscience is going to be soothed when considering the cases of those of us who, previous to the inauguration of the national scheme, were participants in local schemes in which the benefits were no less and to which there was a contribution at a lower percentage rate than the Government propose. When a teacher changed over

from local to national did he contemplate for *an instant the possibility of the Government* scheme being materially altered? Is there no question of breach of faith in this proposal?

WHAT IS A FULL-TIME TEACHER?

Whilst on the subject of pensions, I feel that attention must again be drawn to the extremely unsatisfactory position in which we technical teachers find ourselves. There are two main points. The first is that no information is yet available to us as to our exact position on that scheme: the second is the apparently extraordinary attitude of the authorities on the definition of a "full-time teacher."

In one sense the first point which I have mentioned turns upon the second. The Act says in effect that full-time teaching service shall be recognised as pensionable service, *and it would appear that the Government* seeks to make some definition of the phase "full-time teacher," which will reduce both the number of technical teachers who could possibly benefit by the scheme and the number of years of service under which pension could be claimed. We have a very distinct grievance here: very definite, very serious, and a heavy penalty on Technical Teachers.

The whole trouble would appear to arise from the fact that technical teachers have to work very largely on the split-shift system. No difficulty arises in the recognition of a full-time teacher in a Primary or Secondary school; but because the technical teacher has to work mornings and evenings on some days, afternoon and evenings on other days, and mornings and afternoons on others, the *Government professes to be* unable to say whether he is a full-time teacher or not. The presumption is that it desires to count him out. The Burnham Committee defined a full-time teacher as *distinct from* a part-time teacher, as one who held a full-time appointment. That appears to be insufficient for the Government, and they now seem to be seeking to define a full-time teacher in terms of hours of active teaching and of actual attendance as to create a most serious position. The hours of service of the Primary and Secondary teachers are unquestioned—but because the Technical man has to endure the hardships of split shifts, the social isolation it entails, and the greater strain upon his endurance and fortitude, his service is to be questioned as full-time service. This, is in spite of the fact that the terms of his appointment "shall give his whole time to the duties of the post and shall not take up any other appointment."

The net result is that we none of us know what benefits—if any—are likely to come to us under the pension scheme. It is an *intolerable* position, and whilst we recognise that the clerical work involved in giving definite information to any individual may be so great that it will take a few years to give it to everyone, we can see no reason why the *general principles of recognition* should not be stated definitely. We urge this very strongly indeed, and in doing so express the very firm opinion that all service rendered in a "full-time appointment" should be recognised as pensionable service.

The hesitation in doing so can only be put down as an example of the lack of knowledge of the work of Technical teachers.

THE PLACE OF THE PART-TIME TEACHER.

The place of the part-time teacher in the scheme of Technical education is one in which we are keenly interested. It is of the greatest importance that we should keep in touch with industrial development and industrial problems. In certain branches and stages of technical education *it is quite impossible for a full-time teacher* to have the same detailed knowledge of current practice and current problems as a man actively engaged in the industry or profession. If the service of someone actively engaged in some responsible and authoritative position can be obtained as a part-time teacher his work will be the flux which will help to weld together fundamental scientific principles underlying the industry and the actual practice obtaining. Such work is of extreme importance, and the part-time teacher of the type indicated must be regarded as an essential factor of any scheme of Technical Education.

(To be continued.)

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(Continued from Last Week).

EXPERIMENTS.

PART A—BENZOTHIAZOLES.

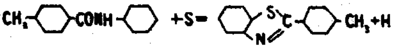
1. *Oxalamino-thiophenol.*

In order to become familiar with the

pounds, this synthesis was attempted as a starting point, since it involves a sulphur fusion which may be considered typical. 300 g. of acetanilide was heated with 180 g. of powdered roll sulphur following the directions of A. W. Hofman.[48] The weight of the melt at this point was 282 g., which was then treated according to the directions of Lauth[49] for extracting the pure compound. 60 per cent. sulphuric acid, by weight, extracted only 140 g. of the melt corresponding to a 50 per cent. yield against 60-70 per cent. as given by the original article. Crystallization from boiling aniline yielded a coloured product, and as the solubility in ethyl alcohol is less than 1 g. per100 cc., and it is equally or more insoluble in ether, nitrobenzene, aniline, amyl alcohol, amyl acetate, and mixtures of these, it was decided that purification by other methods than sublimation was impracticable. Sublimation of 75 g. yielded 7 g. of white, odourless needles, melting at 304° (Unc.), which was then recrystallized from a large volume of ethyl alcohol. The final yield, calculated back, was less than 5 per cent. of the acetanilide used, and was considerably less than that given by either of the previous investigators.

The extreme minuteness of the yields proved to be a regular occurrence in all similar experiments, and this, as well as the difficulty in obtaining the intermediates required, was a continual source of vexation and a serious handicap to the progress of the work. For this reason the synthesis in each case are given fairly completely to save time wherever it may be necessary or desirable to duplicate or continue the work. The yields described in this dissertation have all been actually obtained and can be duplicated by fairly careful manipulation.

In accordance with the first and third purposes of this research, it was considered desirable to prepare a homologue of the "Rosenkörper" and to determine whether it would exhibit an odour resembling that of the interesting substance obtained by Hofmann. With all the methods, previously enumerated, available, it was decided to attempt the synthesis of 2-paratoyly-benzothiazole, which, if successful, would be a new contribution to the chemistry of the group, by the original method of Hofmann, which should proceed as follows:



Paratolanilide was required as a starting material, and as it was not available, the synthesis was perforce accomplished from paratoluidin.

2. *Paratoluyl Nitrile.*

This compound was made following the directions of Gatterman[50] and of Fisher.[51] The reaction proceeds as described, and the yields and melting points coincide with the accepted ones.

3. *Paratoluic Acid.*

Prepared according to the directions of Gatterman and Fisher as just given. Yield and M.P. were as recorded.

4. *Paratoluyl Chloride.*

As first attempted, a method adopted from Gatterman's[50] preparation of benzoyl chloride was employed. The reaction does not proceed satisfactorily, and after two trials it was discarded.

The compound was synthesized by the method of Frankland and Wharton[52] (see also F. and Aston) and the yield was 55-60 per cent. of product boiling from 182° C.-185° C. at a pressure of 260 mm.

5. *Paratolanilide.*

The literature furnishes a number of methods for this synthesis by Wegerhoff,[53] Brückner,[54] Fischli,[55] and Leuckhardt,[56] and the observed melting points vary from 139° C. (Fischli) to 145° C. (Leuckhardt).

Since paratoluyl chloride was available from the previous synthesis, the method of Fischli was selected and modified.

In a one litre xask, dissolve 15 g. (18 cc.) of freshly distilled aniline in 200 cc. of

48. Hofmann (see 12).
49. Lauth (see 39).

50. Gatterman, *Practical Methods of Org. Chem.*
51. Fisher, *Lab. Man. of Org. Chem.*
52. Frankland & Wharton, *J. Chem. Soc.*, 69, 1311 (1896).
Frankland & Aston, *J. Chem. Soc.*, 75, 484 (1899).
53. Wegerhoff, *Ann.*, 252-12 (1889).
54. Brückner, *Ann.*, 205-132 (1880).
55. Fischli, *Berichte*, 12, 615 (1879).
56. Leuckhardt, *Jour. Prak. Chem.* (2), 41, 306 (1890).

water-and alcohol-free ether. From a dropping funnel add slowly with good stirring 25 g. of paratoluyl chloride. The reaction proceeds smoothly according to this equation:

$$CH_3C_6H_4COCl + C_6H_5NH_2 = CH_3C_6H_4CONHC_6H_5 + HCl,$$

the product separating out at once as a fine white precipitate. Evaporate off the ether, or better, distill off on a water bath, and dissolve the residue in the least amount of 50 per cent. ethyl alcohol, in which the solubility is about 5 g. per 100 cc., by warming. Allow to cool, filter by suction, and wash with cold water. The yield is *practically quantitative*, and the purity of the product is satisfactory for most purposes. On recrystallization from ethyl alcohol it appears in shining white plates, M.P. 145° C. (cor.).

6. 2-*Paratolyl Benzothiazole* (A).

The first attempt to prepare this compound was, as has already been mentioned, according to Hofmann's first general method, the fusion of the anilide with sulphur.[57] A mixture of two parts by weight of paratolanilide and one part of powdered roll sulphur was placed in a flask equipped with a reflux air condenser, and kept at a temperature of 290° to 300° C. for two hours on an oil bath. At the end of this time the melt was poured into a beaker, allowed to solidify, and powdered. The weight of the fusion mixture at this point was 1.5 to 1.6 parts in several experiments, and was dark brown in colour. It was extracted repeatedly with 100 cc. portions of concentrated hydrochloric acid (39 per cent. HCl by weight, specific gravity, 1.2) and the liquid extract diluted with water, but no precipitate formed. On neutralization with sodium carbonate and long standing, a small amount of yellow material, insufficient to purify, was deposited, and a solution of this in alcohol and in concentrated hydrochloric acid gave a yellow precipitate with 1 per cent. gold chloride solution, a reaction which is characteristic of these bases. Alcohol and ether extractions of the melt gave similar results, and it is probable that the yield of the desired substance in the reaction is positive, but certainly less than 1 per cent.

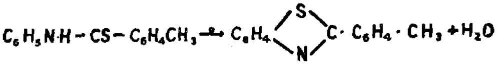
57. (See 5, 12, 25, and 27).

It was thought, however, that the direct fusion of the two substances might have been responsible for the low yield, due to too powerful oxidation and consequent charring, and accordingly the addition of naphthalene as a diluent was next tried. The melts were made u pas follows:

Paratolanilide	12 g.
Naphthalene	12 g.
Roll Sulphur	6 g.

according to the method described later for dehydrothiotoluidin. They were heated for two hours starting at 160° and ending at 200°. At the end of the first hour a marked colour change to yellow occurs, but the desired substance was not found in the final mixture.

Hofmann's method for preparing the desired compound having failed, it was next decided to attempt its synthesis analagously to the method by which Jacobson[58] had obtained the "Rosenkörper," for which the reaction should be in this case:



Thioparatolanilide was required as a starting substance and as this was not available, it was again necessary to prepare a number of intermediates.

7. *Thiocarbanilide*.

Prepared from aniline and carbon disulphide according to Gatterman.

8. *Phenyl Mustard Oil*.

This was made from thiocarbanilide as described by Gatterman.[59]

9. *Thioparatolanilide*.

This compound was synthesized by the method of Gatterman, whose method is simpler than that of Leo, which has already been mentioned in the introduction. Since the substance was required in fairly large quantities, it was found necessary to modify the original method somewhat, as it is undesirable to use amounts much larger than those in the above-mentioned paper, because of the tendency of the aluminium chloride to cake, with an accompanying reduction in yield. It is preferable

58. (See 15).
59. Gatterman, *Jour. Pr. Chem.* (2), 52, 575 (1899).
(See also Friedman and G., *Berichte*, 25, 3527 (1892).

to carry out the reactions in separate vessels. The ensuing directions involve about the maximum quantities with which it is possible to secure satisfactory results, but by running a number side by side, much more can be made without a great increase in the time necessary, and with very good yields.

A mixture of 15 g. of phenyl mustard oil, 30 g. of toluene and 30 g. of aluminium chloride (anhydrous) is allowed to stand, in a one litre flask with an electric stirrer, on a water bath for two hours, and then to complete the reaction, is left over night. Decompose the solid reaction product carefully with ice water, and distill off the unchanged toluene and phenyl mustard oil with steam. On more than one run this may, of course, be done successively with the same apparatus. The residual liquid in the xask is poured into a beaker and deposits, on cooling, a solid which consists chiefly of the anilide, but contains some alkali-insoluble impurities. Filter off, and if more than one preparation is being made, unite the yields at tbis point.

Warm the solid material with 10 per cent. KOH using 300 cc. to each run, and filter. Extract a second time, using 150 cc. to each. (The solubility of the anilide is about 9.2 g. per 100 cc. in the dilute alkali at 20° C.) Unite the filtrates and neutralise with 20 per cent. sulphuric acid. Yield is 80 per cent. of the theory, and the purity is sufficient for most purposes. (This yield may be cut to 40 per cent. simply by using double the quantities directed.)

Thioparatolanilide may be recrystallised from ethyl alcohol, in which the solubility at the boiling point is about 30 g. per 100 cc., in which it gives a red solution, which on cooling, deposits yellow needles melting at 142° C. (cor.).

10. *Paratolylbenzothiazole (B).*

From the compound just described, the new sulphur base was prepared successfully by an adaptation of the method of Jacobson.[60]

In a litre beaker, dissolve 16 g. of thioparatolanilide in 700 cc. of water containing 60 g. of sodium hydroxide. (An equal weight of potassium hydroxide can be used with the same results.) It is necessary to warm to effect solution. Allow to cool to room temperature and add 227 cc. of a 20 per cent. solution (containing 45 g. of solute) of potassium ferricyanide. The mixture becomes milky yellow at once. Allow to stand twenty-four hours and filter off the resinous precipitate.

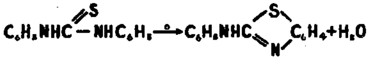
Extract twice with 150 cc. and 100 cc. of concentrated hydrochloric acid respectively, filtering through asbestos each time. The solid becomes a bright red at first, on addition of the acid. Mix the extracts and drown them in ten times their volume of water. After extraction all but a small amount of material which is an oil below 100°, but solidifies to a gummy mass, should have dissolved. The precipitate on the addition of water is voluminous and pale yellow in colour. The weight is 60-75 per cent. of the theory according to the equation given above. There is no advantage in neutralising the acid with sodium carbonate.

Absolute purity requires several recrystallisations from alcohol, as the impurities, though small in quantity, are difficult to remove, which finally yields it in colourless, odourless needles, melting at 85° C. (cor.). When slightly moist with alcohol, the new base has a faint odour which is somewhat suggestive of "Rosenkörper," but its intensity is so small as to be barely perceptible. *Analysis*:

Calculated for $C_{14}H_{11}NS$	N =	6.22%
Found	N =	(6.55% (6.46%

11. *2-Phenylaminobenzothiazole.*

In the light of the synthesis just given, it occurred to the author that the 2 phenylaminobenzothiazole which has previously been prepared by Hofmann and others, should be formed by the oxidation of thiocarbanilid in the Jacobson reaction, according to the equation r



Accordingly the experiment just described was repeated, using the same molecular quantity of thiocarbanilid instead of thioparatolanilide. The precipitate which formed in the oxidation mixture was found to be practically insoluble in concentrated hydrochloric acid, the liquid extract on dilution with water depositing only a trace of gray-white substance which on a single crystallisation from ethyl alcohol melted at

60. (See 15).

144.5° C. (cor.) and may have been the desired compound, but the amount was too small to identify. The residue was yellow in colour and had lost very little in weight, and from it a substance soluble in alcohol, from which it crystallised in yellow needles melting at 237.5° C., was isolated.

At the end of one of his papers, Jacobson makes a brief reference to having tried this reaction, and mentions carbanilid as one of the products, the other being an amorphous, insoluble material that was not investigated. This may be prepared as follows:

Dissolve by heating, 18.0 g. of thiocarbanilide in 800 cc. of water to which has been added 60 g. of sodium hydroxide. All will not quite dissolve. Cool and add a solution of 52 g. of potassium ferricyanide in 260 cc. of water. Let stand 24 hours, filter, and dry. Residue is yellow in colour, and weighs 16 g.

Extract with 150 cc. of 95 per cent. ethyl alcohol by heating. Filter. A second extraction is unnecessary. The residue is yellow, weighs 7 g., is highly insoluble in all ordinary solvents, except nitrobenzene, from which, however, it was not successfully crystallised, and is evidently the product mentioned by Jacobson. After some difficulty, his other observation was also verified. The filtrate was allowed to crystallise, and then the product repeatedly crystallised from alcohol, yielding finally a substance melting only slightly below carbanilid but exhibiting a yellow colour and giving a qualitative test for sulphur. It was attempted to hydrolyze this compound, using 30 per cent. aqueous potassium hydroxide, and 20 per cent. alcoholic potash in different experiments. Both yielded the same substance, which appeared in white, shining needles on recrystallisation from ethyl alcohol, melted at 238° C. (cor.), were free from sulphur, and gave the bromine addition product characteristic of carbanilid. (As did also the original substance.) Contrary to the test given by Mulliken [61] carbanilid is apparently not hydrolyzed rapidly by alcoholic potash which does, however, remove the sulphur-bearing impurity. This can also be done by shaking the original material with alcohol in which the carbanilide dissolves more rapidly and leaves a small amount of yellow material, too little to examine, however, at the bottom of the vessel. The extreme insolubility of the first substance made impossible any further investigation of it.

The aniline blues and reds are among the most important of the triphenylmethane dyes and have been prepared in a number of ways, from benzyl chloride, para rosaniline, and aniline, diphenyl amine, etc.,[62] and of this group probably the best known is aniline blue itself, to which the structure

$$(C_6H_5NHC_6H_4)_2:C:C_6H_4:N.C_6H_5.HCl$$

is ordinarily assigned. The last mentioned synthesis of this compound suggested that, since phenylaminobenzothiazole contains a secondary nitrogen group and is structurally closely related to diphenylamine, it would react similarly in the Hausdörfer reaction, yielding upon fusion with oxalic acid, a substance whose probable structure would be

$$(C_7H_4NS.NHC_6H_4)_2:C:C_6H_4:N\text{—}SNC_7H_4$$

Reasoning by analogy, this compound should be a direct silk dye and probably have a colour in the blue-green region of the spectrum.

As has been previously noted, phenyl aminobenzothiazole has been synthesized by a number of methods which may be briefly summarised:

(1) From phenyl mustard oil and phosphorus pentachloride, followed by treatment with aniline, by Hofmann.[63]

(2) From anisyl and thioanisyl mustard oils by Hofmann.[64]

(3) By Jacobson and Frankenbacher from phenyl mustard oil and azo-benzene.[65]

(4) By hydrolysis of the dibrom addition product of thiocarbanilid with sodium carbonate, by Hugershoff.[66]

61. Mulliken, "Identification of Pure Organic Compounds."

62. Fischer, *Berichte*, 15, 678 (1882).
Nötling, *Berichte*, 15, 1453 (1882).
Zimmerman & Müller, *Berichte*, 18, 993 (1885).
Hausdörfer, *Berichte*, 23, 1963 (1890).
Nötling, *Berichte*, 24, 553 (1891).
Weil, *Berichte*, 29, 2677 (1896).
Hofmann, *Ann.*, 132, 160 (1864).
Wedekind, *Ann.*, 307, 291 (1899).
Central Blatt, 1908, 510; *D. R. P.* 67013.
Jahres Ber. Chem., 1863, 418.

63. (See 3).

64. Hofmann, *Berichte*, 20, 1176 (1887).

65. (See 36).

66. Hugershoff, *Berichte*, 36, 3127 (1903).

Consideration of the methods available led to the selection of the fourth as being the simplest both from the standpoint of manipulation, and ease in obtaining the necessary reagents, for the difficulty in preparing starting materials was a continually vexatious matter in the course of this research. Accordingly the compound was prepared by the method of Hugershoff, which was found to yield the amount of product recorded by him, in a good state of purity, with a great deal of unnecessary labour, a thing which in almost every preparation in the thiazole field was a decided handicap, for many of the reactions which were met with during this work, did not give the yields which the context would seem to indicate, and the problem of purification is always a peculiarly difficult one because of the number and nature of the by-products of the reactions, as well as in many cases the extreme insolubility of the principal substance in most ordinary solvents.

2-Phenylaminobenzothiazole is a colourless, odourless solid crystallising from ethyl alcohol in small crystals, melting at 161° C. (cor.). As its physical properties as well as the chemical and physical properties of the new dye differ somewhat from those of the corresponding substances in the aniline blue reaction, it was necessary to modify the procedure in order to apply it to the case in hand.

12. *Tri (2 Anilinobenzothiazolyl) Carbinol.*

A mixture of 20 g. of phenylaminobenzothiazole and 10 g. of oxalic acid is heated to 170° on an oil bath in a flask equipped with a reflux air condenser and 10 g. more of oxalic acid is added in the course of 15 or 20 minutes. The temperature of the reaction mixture is then raised to 190° and kept there for two hours. It foams at first, probably due to decomposition of the acid, but at the end of the time remains in a state of quiet fusion. Pour into a beaker and allow to cool and solidify.

Grind up in a mortar and extract twice with hot water to remove the excess oxalic acid. The water acquires a slight purple colour and a purple mass remains. Dissolve in 150 cc. of boiling 96 per cent. ethyl alcohol and add 5 cc. of concentrated hydrochloric acid. The dye will not crystallise out on standing, and the solution is evaporated to a gummy paste to which is added 40 cc. of ethyl alcohol and a solution of 2.5 g. of sodium hydroxide in 20 cc. of ethyl alcohol. (The last two steps may be omitted as is obvious on consideration, but are recommended for purification.) Heat under a reflux condenser for one hour and allow to stand for 24 hours. A white precipitate settles out and the supernatant liquid is brown in colour.

Filter and neutralise to litmus with dilute (1:1) hydrochloric acid. The liquid becomes purple as the neutral point is approached, and a small amount of resinous material separates out. Filter this off and reject it.

(To be Continued.)

DEFINITION OF RELATIVITY.

By F. H. Loring.

Confining our attention to the purely relative characteristic of Relativity as enunciated by Einstein, this may be reduced to a comparatively simple statement. The Mechanics of which Newton was the chief exponent and chief contributor, simply made *space* and *time* instantaneously extensive, and they were tacitly understood to be *independent* of each other. For example, the *unit* of time was the same under all conditions, and therefore when the *second* was considered, its *sameness* was everywhere. There was no alteration of this unit from a relative point of view. However fast a person moved past a clock the fraction of time called a second was observed always as a second. Similarly, space had the same fixed universality, regardless of relative movement. Consequently a standard length, which is, as it were, a structural unit of space, was the same to an observer, either moving very slowly or moving exceedingly quickly past it. It will be seen that these ideas of the absoluteness of space and time implied that whatever units were chosen they would be the same under all conditions, and it could be said that space and time units were instantaneously extensive, for whenever they were considered they would be the same everywhere.

Einstein, however, practically said that when you introduce time and length into your calculations, you must consider them as *not* instantaneously extensive and their units *not* absolute; that is to say, these

units would *not* always be fixed and unchangeable. The reason for this is that it was found that certain phenomena led to conflicting and paradoxical results when attempts were made to analyse them in the orthodox manner. Einstein showed that they could be cleared up and co-ordinated by giving time and space units a changeableness in strict accordance with H. A. Lorentz's equation termed the *transformation equation;* because, in passing observationally from one moving body, or co-ordinate system, to another, this equation transformed the units of space and time. For example, an observer moving relatively to a clock would observe the "second" of time altered in the proportion 1 to $\sqrt{1-v^2/c^2}$, where c is the velocity of light and v is the velocity of the observer relative to the clock.

Similarly, relative lengths would have to be changed, that is to say, the unit of length would suffer a change (contraction) by relative observation, *i.e.*, one involving relative movement. This is, moreover, consistent because length can be defined so as to involve time. For instance, the length of a body can be indicated by the time taken to traverse it, the traversing movement being uniform.

The term *instantaneously extensive* is here introduced purposely to show that nothing can be instantaneous which involves appreciable distance; for, the quickest action, that of the propagation of light, is not instantaneous, but it takes a perceptible time for its propagation; hence its velocity (c) must enter into the equation if we take the quickest movement known as a criterion for movement; and when this constant (c) is used, the equation gives the answer agreeing with experiment in every case. Hence it will be seen that the term *relativity* signifies that all the factors suffer a relative adjustment as regards their fundamental units entering into the problem, and the velocity of light becomes a constant in the calculations. Mathematically co-variant equations are employed.

With small relative velocities there is no appreciable change, but as the relative velocities approach that of light the change becomes appreciable.

In applying this principle involving the Lorentz transformation, it will be seen that each phenomenon or event considered has its own time and length units by analysis (the local time thus becomes the real time) so that they become, as it were, attached to the particular event. The reason for this may have partly arisen from the fact that in applying the calculus, which gives the right answer every time, one is introducing an analytical principle peculiar to the calculus itself. This is not new. It has long been known that the calculus afforded a powerful means of analysis. Einstein, however, went a step further—but it was a great step—in giving phenomena themselves the characteristics of the calculus, which meant that time and space must be considered relatively, in which case the units of time and space were no longer fixed, but suffered a change according to the amount of relative movement; and, as a consequence, each event had its own time and length.

Pressing this idea a stage further, the æther no longer becomes *instantaneously extensive*—if this term may be applied to the æther—but the æther is in consequence, as it were, attached to each event, so that the term *æther* is either a singular or a plural term, like *sheep*.

Thus it will be seen that space takes upon itself physico-mathematical characteristics and, when this conception is extended to gravity and the *principle of equivalence* introduced, this phenomenon falls into line and becomes an extension of the relativity idea. This accomplishment is classed under the head of *General Relativity*, while the earlier generalisation is referred to as the *Special Relativity*.

Minkowski brought time and space into union by making time the *fourth* dimension in his equations, so that space and time could not be separated since they became parts of a wider conception (space-time continuum, or four-fold manifold, or four-manifold to express it briefly), and this will be evident from the fact that one could not consider a block of space without implying by analysis *length, breadth and height.* These are inseparable constituents. When *time* is introduced by necessity, this becomes the *fourth* constituent, and on the same line of reasoning it becomes an inseparable constituent of the scheme. This means that an event has to be specified in all *four* dimensions completely to describe it analytically; thus *time* becomes the fourth dimension by implication.

The alternations in time and length involved in the theory of relativity seem to imply that they are conditioned by the

phenomena which they are used to describe.

The velocity of light in a vacuum is a constant in the equations. Moreover, this velocity (c) is supposed to be really constant regardless of any movement of the observer relative to the light source, i.e., as measured by the moving observer. This is true of necessity, since by this system of analysis the units of space and time no longer remain constant when observed relatively, and this brings about the constancy of the velocity of light in a compensative way. Strange as this may seem, the interpretation of experimental results leads directly to this conclusion,* though there is no direct experimental evidence that the velocity of light in a vacuum would always be constant, whatever be the observer's motion.

The theory of relativity alters the conception of space and time in their relation to physical phenomena, and the analytical presentation of phenomena is in consequence altered. This theory, moreover, endows space with physical properties, and the physical properties of space become bound up with a mathematics of space which becomes particularly evident in the development of the theory to co-ordinate gravitational phenomena with mechanics in general as developed by this new theory.

* Accepting this constancy in the velocity of light, and reasoning back therefrom, we arrive at the conclusion that the relative view, as given above, is the true analytical interpretation of experimental knowledge of the kind involved in this discussion.

PROCEEDINGS AND NOTICES OF SOCIETIES.

ROYAL SOCIETY.

LIST OF PROBABLE PAPERS FOR READING JUNE 29, 1922.

Sir J. J. Thomson, O.M., F.R.S.—On the Analysis by Positive Rays of the Heavier Constituents of the Atmosphere; of the Gases in a Vessel in which Radium Chloride had been stored for 14 years, and of the gases given off by deflagrated Metals.

Sir Robert Hadfield, F.R.S.—The Corrosion of Iron and Steel.

W. B. Dawson, D.Sc.—Harmonic Tidal Constants for Standard Ports of Reference in Canada. Communicated by Prof. F. D. Adams, F.R.S.

Prof. J. C. McLennan, F.R.S., and M. L. Clark.—On the Excitation of Characteristic X-rays from Light Elements.

J. C. Bramwell.—An Abnormal Relationship of the Electrical to the Mechanical Response in the Ventricles. Communicated by Prof. A. V. Hil, F.R.S.

T. S. P. Strangeways.—Observations on the Changes seen in Living Cells during Growth and Division. Communicated by Mr. W. B. Hardy, Sec. R.S.

SOCIETY OF GLASS TECHNOLOGY.

A meeting of the Society was held on Wednesday, June 21st, 1922, at 2.45 p.m.

A selection from the following papers was read and discussed:—

"The Composition of Lime suitable for various purposes in Glass Making," by Miss V. Dimbleby, B.Sc., and Prof. W. E. S. Turner, D.Sc.

"The Swelling of Sand on absorption of moisture, and its effect on Batch Mixing," by L. E. Norton and Prof. W. E. S. Turner, D.Sc.

"The Mixing of Batch," by Miss V. Dimbleby, B.Sc., A. W. Dickenson, and Prof. W. E. S. Turner, D.Sc.

"On the Devitrification caused upon the surface of Sheet Glass by heat," by Y. Amenomiya.

"Note on the effect of Alumina in retarding the Devitrification of Glass," by K. Kamita and Prof. W. E. S. Turner, D.Sc.

MINERALOGICAL SOCIETY.

A meeting of the Society was held on Tuesday, June 27th, at 5.30 p.m., when the following papers were read:—

Dr. W. F. P. McLintock and S. R. Ennos: The structure and composition of the Strathmore meteorite.

A. Brammall and H. F. Harwood: The Dartmoor Granite (part), its petrology and accessory minerals.

H. F. Collins: On some crystallised sulphates from the Province of Huelva, Spain.

Prof. H. Hilton: The graphical determination of the constants of a shear.

Prof. H. Hilton: A note on crystallographic notation.

A. F. Hallimond: Glauconite from Lewes.

Dr. L. J. Spencer: Ninth list of new mineral names.

CHEMICAL NOTICES FROM FOREIGN SOURCES

Further Details of the Second Congress of Industrial Chemistry, to be held at Marseilles from July 2nd—8th, have now been published, and tickets can be had on application to the General Secretary, M. Jean Gérard, 49, Rue des Mathurins, Paris, VIII. Railway tickets, at prices which are reduced by 40 per cent., can be obtained by the members of the Congress who are travelling in parties of not less than 10. There will be a special boat down the Rhône from Lyons to Marseilles on Sunday, July 2nd, and a special train will run from Avignon to Marseilles. Full lists are given of the hotels and restaurants of Marseilles, with the charges for rooms and meals, and accommodation can now be booked. All the arrangements appear to have been excellently organised, and no pains have been spared to make the Congress a complete success.

Phosphorescent Zinc Sulphide—*A. A. Guntz.* — Zinc sulphide is dimorphic, and both varieties are phosphorescent. The two varieties can easily be distinguished under the microscope. One, wurtzite, is composed by small octahedric crystals which act strongly upon polarised light. The other form, sphaterite, occurs in lamellæ, and has no such action. There is a very small difference in the densities of the two varieties. The phosphorescence only appears in presence of a trace of a heavy metal; with copper in the proportion of 1 to 10,000, both varieties emit a green light, but the duration of the luminosity is different. The phosphorescence of wurtzite is more persistent, but the decrease in the intensity of the light is very rapid. When placed in different regions of the spectrum the two varieties show no differences as regards the duration of the phosphorescence. In the infra-red they show the same phenomenon of extinction, preceded by a slight recrudescence of luminosity. Both varieties are exceedingly thermoluminescent and triboluminescent. The rays of radioactive compounds act on both forms, but blende appears to be rather more sensitive to them. X rays act like light in producing luminescence, but the two varieties do not show the characteristic difference in the respective durations of the phosphorescence when subjected to X rays. — (*Comptes Rendus*, CLXXIV., 1922, 1858).

Preparation of Organo Metallic Compounds. Application to Ethyl Iron Iodide—*André Job and René Reich.* — The authors have observed that the organo zinc compounds act upon many anhydrous chlorides, and they conclude that probably organo metallic compounds exist in all series. They have tested this conclusion in the case of the compounds of iron. An ethereal solution of ferrous iodide FeI_2 can be prepared directly by shaking an excess of reduced iron with iodine in anhydrous ether, the solution being carefully kept out of contact with air. Then an ethereal solution of C_2H_5ZnI is added, the whole being kept in an atmosphere of CO_2. The solution is kept at the boiling point of ether for six hours, and is then taken up with water. Ethane is given off and ferrous hydrate is precipitated. The reaction which occurs is represented by the equation

$$C_2H_5\,Fe\,I + H_2O = C_2\,H_6 + Fe\begin{cases} O \\ OH \end{cases}$$

and thus it appears that the C_2H_5 Fe I is formed by a double decomposition

$$C_2H_5\,Zn\,I + Fe\,I_2 = C_2H_5\,Fe\,I + Zn\,I_2$$

Ethyl iron iodide reacts with absolute alcohol to give ethane and ferrous iodo-ethylate A corresponding ethyl iron chloride can be prepared by a similar method, and the authors are now applying the method to the phenyl series, and are also trying to prepare compounds of the type Fe R_2 and Fe R R′.—(*Comptes Rendus*, CLXXIV. 1922, 1358).

GENERAL NOTES.

We have received from Messrs. Adam Hilger, Ltd., a pamphlet calling attention to their Hilger Quartz Spectrographs E and E3, together with an excellent photogravure of the Arc Spectra of Lead and Copper, taken with one of these instruments. The makers point out the value of these instruments, both in research and in certain classes of routine work in Industrial Laboratories, and give a list of well known firms in whose works they are already installed.

In the House of Commons last week, Mr. Baldwin, in reply to Dr. Murray, said that he was aware that statements had been made that certain Organic Chemicals obtained from firms in this country had been

found impure and useless for experiment. He would suggest that research workers and others concerned should place themselves in direct communication with British manufacturers of fine chemicals, who would welcome any detailed criticism and co-operation in the development of the industry to their mutual advantage. He would also point out that the importation of these materials was not prohibited.

NOTICES OF BOOKS.

The Analysis of Non-Ferrous Alloys, by F. IBBOTSON and L. AITCHISON. Second edition; pp. VIII. + 246. London: Longmans, Green & Co., 1922. Price 12s. 6d. net.

Since the first edition of this work appeared in 1914, the importance of Non-Ferrous alloys has enormously increased, and in addition, the war has brought to the fore alloys previously unknown or very little used, *e.g.*, those of Aluminium.

In the present edition, the authors have included analytical methods for these, and have also considered recent improvements on older methods for the estimation of other metals alone, and in alloys such as brasses, bronzes, white metal, etc. It is perhaps a sign of the times that, wherever possible, electrolytic methods are now preferred, as they possess advantages of speed, cleanliness and accuracy. The authors describe these recent processes and the apparatus in adequate detail, and also give the most convenient precipitation and volumetric processes.

Numerous methods and modifications have been described in the scientific journals, and the authors have selected those of proved utility, including several of their own that have appeared from time to time in *The Chemical News*.

From his experience in the estimation of tin, the reviewer is convinced that the authors have included very satisfactory methods for determining this element, and doubtless the same applies to those given for other metals.

In view of the present interest in non-ferrous alloys this second edition will be especially welcomed by metallurgists, works' chemists, analysts, and others who are concerned in the use of these metals and their alloys. J. G. F. D.

Coal Tar Colours in the Decorative Industries, by A. CLARKE, F.C.S. Pp. XIII. + 166. London: Constable & Co., Ltd., 1922. Price 6s.

The utility of coal-tar dyes in the decorative industries has not been fully realised, possibly because the earlier coal-tar dyes and their lakes were fugitive or "bled. This objection exists no longer, since it is possible to obtain dyes of excellent fastness, and perfectly insoluble lake pigments in almost all shades.

The author describes the classification and the nature of various types of dyes, and processes of dyeing. He then deals with the uses of the various colours used for dyeing or colouring leather, fur, wood, paper, etc.

In the last few years the manufacture of yarn and fabrics, of satisfactory wearing qualities, from paper, has assumed large proportions in Germany, as substitutes for textile materials, and should increase the demand for the various basic, direct, sulphur and vat dyes which can be used with this material.

Except that *quinoline* and *naphthalene* are wrongly spelt on page 103, this very readable book is free from errors and should commend itself to chemists and industrialists concerned with the decorative industries. J. G. F. D.

Fluidity and Plasticity, by E. C. BINGHAM, PH.D. Pp. XII. + 440 + I plate. New York: McGraw Hill Book Co., Inc. (London: 6 & 8, Bouverie St.) 1922. Price 20s.

Whilst the flow of electrical energy has been very fully studied and developed into an important science, our knowledge of the flow of *Matter* is meagre and remains largely empirical. Yet the flow of liquids is a subject of great importance to engineers.

Poiseuille, in 1842, was the first to demonstrate the simple nature of flow in capillaries, which is in contrast with the complex conditions of flow in wide tubes. He wished to understand the exact nature of the flow of blood, being interested in internal friction from the physiological point of view. He established what is now known as the Law of Poiseuille, which Prof. Bingham has amplified.

It is pointed out that plastic solids do not follow the law in their flow.

Among the chemists who have since investigated this subject, mention may be made of Graham, who carried out researches on Liquid Transpiration and Liquid Diffusion; Rellstab; Přibram and Handl, and Thorpe and Rodger, all of whom studied Specific Viscosity and its connection with Chemical Constitution.

Arrhenius, Ostwald and other physical chemists have paid some attention to the viscosity of aqueous solutions, but our knowledge of this subject has not made rapid progress. With physical chemists viscosity has remained in the background.

In the chapter on fluidity and chemical composition and constitution, it is shown that viscosity is closely dependent on the magnitude of the molecules making up the substance.

Various viscometers have been invented and used by different investigators, and the author describes several, but does not include those of Engler and Redwood. In recent years industrial and engineering chemists have devoted more attention to lubricants and the characteristics which should be possessed by the oils and greases employed in lubrication.

A good bibliography has been compiled; references are arranged alphabetically, thus also forming an authors' index. A separate Subject Index is also given. The only slip that has been noticed is on page 275, where benzene is accidentally quoted as a typical paraffin hydrocarbon, instead of hexane.

In his stimulating book, Prof. Bingham has lucidly correlated existing data on the phenomena of plasticity and viscous flow, and has indicated promising lines which may assist in elucidating obscure problems. The work should be well received by engineers and works' chemists, as well as by physicists and physical chemists.

J. G. F. D.

Industrial Nitrogen, by P. H. S. Kempton, B.Sc. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C. Price 2s. 6d. net.

An interesting little booklet dealing with the developments of the Nitrogen industry. The author, in his preface, lays stress upon the importance of the nitrogen industry during the late war. Upon this subject there can, of course, be no two opinions. Interest in the artificial production of nitrates commenced many years ago, and was brought into considerable prominence by the late Sir William Crookes, in his book upon the wheat problem and the necessity for a commercial method of preparing nitrates.

The first few pages of the book deal with the elements of the subject and the natural and artificial fixation of nitrogen. In chapter 3 is given a detailed description, fully illustrated, of the various modern electrical processes that have been devised for the purpose, and another chapter is devoted to catalytic fixation.

The final chapter is given up to the imperial development of the subject, and stress is laid upon the enormous risk of dependence upon foreign sources for the compounds of nitrogen that are essential to the support of the nation—whether for food, the industries, or for protection. The book is well indexed and illustrated, and the author is to be congratulated upon having presented a very important subject in a concise and interesting form.

An Elementary Textbook of Metallurgy, by A. Humbolt Sexton, F.I.C., F.C.S. Sixth Edition. Revised and enlarged by C. O. Bannister, A.R.S.M., F.I.C., with 70 illustrations. Chas. Griffin & Co., Exeter Street, Strand. Price 8s. 6d. net.

The revisor, in a prefatory note, states that the above work was due for revision during the war, but its appearance had to be postponed. It has now been brought thoroughly up-to-date, and much new material has been introduced—details connected with the classification of pyrometers, manufacture of coke and producer gas, copper and lead smelting, the cyanide process of gold recovery, and other matters.

The book is well illustrated with diagrams and pictures of both ancient and modern apparatus.

Catalytic Action, by K. Geo. Falk. Harriman Research Laboratory, Roosevelt Hospital, New York. Book Department, Chemical Catalogue Co., 1, Madison Avenue, New York, U.S.A.

The author, in his book, has presented the subject of catalytic actions and their relation to chemical reactions in a very exhaustive manner.

In the first chapter is given a general review of the subject and the industrial

applications in which catalysis is involved. An interesting chapter is given on a chemical interpretation of life processes. The subject of enzymes, bacteria and other matters directly connected with the life process are discussed in detail.

The concluding chapter of the book is devoted to contact catalysis, in which the work of Langmuir and others is discussed. English readers will be grateful to the author and the publishers for having placed at their command a fund of authoritative information upon an increasingly important subject.

In a work dealing with the "Minor Forest Products of the Malay Peninsula," published by permission of the Federated Malay States Government, Dr. F. W. Foxworthy, Forest Research Officer, gives lists of poisonous and medicinal plants. Large numbers of the local plants, he writes, are used in native medicine, but only a few are recognised in pharmacy. A number of the species included in the list of poisonous plants, he writes, are used in native medicine, but only a few are recognised in pharmacy. A number of the species included in the list of poisonous plants are also of value for medicine, as it often happens that a poisonous plant contains an active principle which, under certain circumstances, may have beneficial physiological effects.

The list of the principal plants used locally for medicinal purposes contains no less than 343 names, and is taken mainly from an official bulletin entitled "Malay Drugs," published by Mr. H. N. Ridley, C.M.G., F.R.S., in 1906. The table gives the family to which each plant belongs, the botanical name, the common name (usually the name given by the Malays), the part used, and the complaints, &c., for which the extract from the plant is used. Occasionally some plant acquires prominence because of clearly fraudulent claims as to its curative properties. This seems to have been the case, some years since, with *Combretum sundaicum*, Miq., which was asserted to be a cure for the opium habit. A careful examination of the plant failed to reveal any just grounds for this claim.

Dr. Foxworthy makes the following comments in the introductory notes to this section of his work:—

Brucea sumatrana, Roxb. (Fam. Simarubaceæ).—Kosum is well known as a plant useful in the treatment of dysentery. The fruit contains a useful alkaloid.

Taraktogenos kurzii, King (Fam. *Flacourticeæ*).—The seeds yield Chaulmugra oil, which is so useful in the treatment of leprosy. This species has not yet been found in the Peninsula, but occurs in Siam and Burma. Our species of *Taraktogenos* and of the related genus, *Hydnocarpus*, are worth investigating to see if they can be used in the same way.

Strychnos spp.—A number of species are found as climbers. None of our species are so valuable as *Strychnos Nux-vomica*; but several of them contain a good deal of active principle in the fruit, and two of them, *S.ovalfolia*, Wall., and *S.quadrangularis*, A. W. Hill, are used as constituents of a Sakai dart poison. Several of the species would probably repay chemical study. Fourteen species of this genus are recorded from the Peninsula.

Strophantus spp. — These are coarse shrubs or climbers, and contain a useful alkaloid, strophantin, in their sap. They seem not to be used as present.

Dr. Foxworthy's publication also contains references to tanning materials, oleo resins and wood oils, fruit or seed oils, essential oils, and dye plants and dye woods. It is the second part of a work dealing with the forest products of British Malaya, the first having been devoted to trees and timbers.

Volume 6, 1921, of the *Reports on the Progress of Applied Chemistry*, issued by the Society of Chemical Industry, is to hand, and contains many important papers on Fuels, Colouring Matters, Dyeing, &c., and an account of the recent developments in glass manufacture by Professor W. E. S. Turner, who also contributes an article on refractory materials. The article on photographic materials and processes is contributed by F. F. Renwick.

An important article upon Explosives is contributed by A. Marshall, of the Army Ordnance Department, Kirkee, India, commencing with a resume of American Explosives Law, and he also draws attention to the great dangers that have been incurred since the war in the storing and also in the destruction of explosives.

The preparation of Nitro-cellulose is given in detail, and the propellants used by the Germans and other nations during the war are described. Much detail is given of the serious poisoning properties possessed

by modern explosives, and the article concludes with a chapter dealing with their stability.

The subject of India-rubber is exhaustively treated by B. P. Porrett, M.Sc., F.I.C., and numerous references are given to the literature of this important subject.

The reports are well indexed, and the volume is an extremely valuable treatise on the latest developments in technical chemistry. The price of the book to members is 7s. 6d., and to non-members 12s. 6d., and it can be obtained from Messrs. W. Speaight & Sons, Ltd., Fetter Lane, London, E.C.

We have also received a copy of the second volume of the *Annuaire Lambert*, issued by the Bureau d'Etudes Economiques Industrielles et Agricoles, 12, rue de Miromesnil, Paris.

It contains 300 tables in the 350 pages, and the price is 35 francs.

M. L. Aguillon, former Inspecteur-général des Mines, etc., contributes a preface, and points to the difficulties met in compiling such statistics as these by MM. Lambert, since all belligerent nations ceased to publish vital information during the war.

The Annuaire gives detailed statistics of the production and use of fertilisers and chemical products of service in agriculture for the period 1910-20. It is divided into two parts. The first part deals with the manufacture, consumption and transportation of these agricultural chemicals between the years stated.

The artificial nitrogenous fertilisers mentioned include Sodium Nitrate, Ammonium Sulphate, Calcium Nitrate and Cyanamide. The phosphatic fertilisers include Calcium Phosphate, Superphosphate and Slags. There is also a section dealing with the production of potassium salts in Alsace and Stassfurt, and a brief summary of the potash industry in America during the war.

The second part gives statistical matter relating to agricultural chemicals in the principal countries of Europe and the United States. The alteration of frontiers and the formation of new States consequent upon the war has complicated the authors' task. For instance, in the tables indicating the distribution of Calcium Phosphate, for the years 1910—18, Alsace, Lorraine and Upper Silesia are all included under Germany; and Czecho-Slovakia is included under Austria. In the statistics for 1919—20, Alsace and Lorraine are included under France; Upper Silesia under Germany; Poland and Czecho-Slovakia appear, and the figures for the two States are combined—a procedure which cannot be continued longer.

This "Annuaire" will be of service as a work of reference for economists, industrialists, and others concerned with the scientific development of agriculture.

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

15562—Ashcroft, E. A.—Treatment of sulphide ores. June 2.

15597—Beasley, W. H.—Refining of copper oxide. June 2.

15065—Bloxam, A. G.—Manufacture of black azo dyestuffs. May 29.

15342—Demiens, A. A.—Extracting sulphur from gases containing sulphuretted hydrogen. May 31.

15586—Galbriath, W. L.—Reduction of organic compounds. June 2.

15362—Imray, O. Y.—Manufacture of 2;2 diamino anthraquinone. May 31.

Specifications Published This Week.

159164—Condensite Co.—Production of phenol-aldehyde condensation products.

151156—New Jersey Zinc Co.—Manufacture of zinc oxide.

179982—Delaroziere, F. F.—Manufacture of sodium ferro-cyanide.

180027—Haase, T.—Process for the production of fertilisers containing phosphoric acid and potash.

180110—Kelly, A.—Process for the production of sodium pentaborate direct from boren ores.

180175—Courtaulds, Ltd.—Manufacture of carbon bisulphite.

Abstract Published This Week.

Crystallizing.—Patent No. 178[illegible].—An improved apparatus for crystallizing and separating the salts contained in mixed solutions has been invented by Mr. T. G. Tullock, of Bank Buildings, King Street, St. James, London.

The solution is evaporated by being run down a sloping table, and the salts separate on the table in the order of their solubilities, the least soluble being deposited first.

The table which may be cambered, has projecting edges and transverse inclined battles, and intermediate spreading baffles. The table may be mounted on trunnions so as to be turned to discharge the salts, and may be combined with other tables in triangular or other form so that, on being turned, another table surface is brought into position. The table may be heated by electric resistance extending along it or by other means, and may be covered and the watervapour evolved be drawn off and condensed. Glass covers may be used and the heat of the sun used to effect evaporation.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3247

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

ANNUAL CONFERENCE, 1922.

ADDRESS BY THE PRESIDENT (MR. J. PALEY YORKE).

(*Continued from Last Week.*)

RESEARCH AND CONTACT WITH INDUSTRY.

The part-time teacher also helps to bring the full-time staff into necessary contact with the practical world. We have always laid it down as an essential that teachers of technology should have opportunity for research work and for contact with industry. The opportunity is scant. Suggestions have been made that technical teachers should be allowed to take up research work for firms. We recognise the difficulties and we recognise the possibilities of abuse. At the same time the mutual advantage which would accrue to industry and education would be so great that some scheme might easily be devised whereby the directors of industry could submit the research work to the Local Education Authority and through them to the scientific and technical staffs of the various Technical Institutions in the area. One can see, of course, that all research problems would not arrive that way because of the publicity involved; but some useful work could be done.

Some authorities are providing for six months' leave of absence every six years to enable technical teachers to make direct contact with industrial development either by entering work or by travel. This is an excellent scheme, and should be productive of much good, provided that it be not so hampered with regulations that no man can afford to take the fullest advantage of the offer.

LEARNED INSTITUTIONS AND EXAMINATIONS.

It is not many years since we welcomed the abolition of the Board of Education's system of external examinations in science and art. That system played a tremendously important part in the development of our work, but it was felt that it had played its allotted part and that the time had arrived when it might be abandoned with advantage, lest it should exercise too much restriction on educational expansion. That must always be the tendency of the more or less rigid syllabus.

When the Board of Education's system was abandoned many of us felt very anxious lest other schemes of a local character and with a narrower view should spring up in its place. Our anxiety was not caused by any feeling of resentment that our work should be tested, but by the fear that the method of testing might be such that courses of instruction would become cramped and rigid.

We do not disguise from ourselves the fact that the bulk of students do like to have some kind of an objective—an objective that is to say which shall be a certificate that some standard of attainment has been reached. Superior people may be scornful of the desire—but it is a very human desire after all, and there can be no serious objection to it provided that it does not involve the setting up of a cast-iron system and the moulding of all students to one pattern as though they had been turned out of an automatic machine.

Therefore we look with considerable interest upon the scheme which the Institution of Mechanical Engineers, in conjunction with the Board of Education, has just put into operation.

This is an "internal" scheme, in which the quality of a student shall be judged not only by examinations, but by the record of his work and the reports of his teacher. The examination papers will be framed by the teacher and approved or altered by an "assessor" appointed by the Institution of Mechanical Engineers. Only the Technical Institutions which have been recognised or approved by the Board of Education as being efficient for this purpose may participate in the scheme, and in this way every student who presents himself will have passed through a course of instruction which meets with the approval of the Board.

The merits of the scheme lie in the following facts: (1) That the students' whole work is judged by one who has had the opportunity of watching it closely; (2) that the appointment of an assessor by the Institution of Mechanical Engines prevents any unfair judgments arising out of conscious or unconscious bias on the part of

the teacher and assures a reasonable equality of standard; (3) that greater freedom of educational development is permitted when all students are not working to one cast-iron syllabus.

The scheme seems to be promising, if only it does not become too hide-bound and too heavily tied up in red tape regulations. We shall watch it with interest, but our interest *will speedily evaporate if it should* develop merely into an examination system. It is essential in my opinion that it should *encourage students to make progress* in their profession, and to that end it should be associated in some way or other with the means of attaining corporate membership of the professional Institutions—in this case the Institution of Mechanical Engineers.

Grants and Scholarships.

Amongst the things to which attention will be drawn at the conference is the proposed reduction of grants for scientific research and the reduction of the number of national scholarships for Higher Education. These things are noted not only because such reductions gravely imperil scientific and industrial development, but also *because the percentage reduction in the* estimates for these items is much greater than that for corresponding items in other branches of educational work.

It would almost seem that there is being carried out a definite policy for the starvation of higher work and for the removal of many rungs of that educational ladder about which so much is said whenever our education system is being appraised by onr administrators.

The Labour Party and Technical Education.

We welcome the interest which the Labour Party is taking in educational development, and particularly do we welcome the fact that Technical Education is no longer regarded by that Party with suspicion and distrust. That distrust no doubt arose from the mistaken idea that Technical Institutions were going to teach trades and provide employers with cheap labour; and that in some way or another they represented a form of subsidy to capital at the expense of labour. They are now regarded in a different light. It is seen instead that they provide a means of higher education within the reach and within the means of most people, and in that light they are being welcomed.

Our Chief Workers.

It is with great pleasure and satisfaction that I am able to report that the Council of this Association has been able to recommend the appointment of a stipendiary Secretary to assist the Honorary Secretary to carry out the ever-increasing labours of our Association. We have been well served by our voluntary workers in the past, but our work has grown so steadily, and latterly so rapidly, that we were imposing upon them an intolerable and impossible burden. In *particular, of course, did we burden our* Hon. Secretary, and we are tremendously grateful to Mr. Sirman for the splendid way in which he has responded to the calls made upon him. We are also very glad that he has consented to accept nomination for the Hon. Secretaryship for at least another year, and we look forward to some valuable workbeing done with the aid of the gentleman whom the Council has nominated for the stipendiary Secretaryship.

I would also like to offer congratulations to the Editor of our Journal (*The Technical Journal*), Mr. F. E. Drury, for his successful efforts. He had a difficult task in following our Mr. Abbott—I think that we may use the possessive pronoun—and his success is therefore all the greater.

In Mr. Riley we have an Hon. Treasurer of unsurpassable merit. I am afraid that his work is so excellent and so faultless that it does not receive the publicity which it deserves, nor do we always express to him the gratitude that we feel.

Conclusion.

The first object of our Association as set forth in our Rules and Constitution, is to promote the interests of Technical Education generally. In that we are sincere, and our record of activity during the eighteen years of our existence is proof of that sincerity. The fact that we would also seek to safeguard the professional interests of our members does not detract from that sincerity. I can say with certainty that our organisation has been welcomed by the Board of Education and by the leading Education Authorities as the channel through which they can obtain the opinions of Technical Teachers—who put into practice the educational schemes—who know by

experience the weaknesses and strength of the various parts and who know what Technical Education does and can do.

The proper use of knowledge is in man's keeping, and it is his plain duty to use it for the benefit of mankind.

Knowledge was never intended to be used merely as a form of mental adornment or for the external equipment of what might be called the mental fop. Much of it has been used for that purpose, and there has been too much mental snobbery in the ranks of those who should have shown to all the world that education gives to man that sweet reasonableness, balance, judgment, and kindly indulgence, which go to make *the relationship between* one man and another more nearly in accord with that great commandment, "Love one another."

Our Association stands for the proper use of knowledge—not merely in the materialistic sense, but with a full sense of the responsibilities of civilisation. We may deplore many of the products of civilisation, but we have some responsibility for them, and it is our plain duty to so train the mind of man that he may be able to acquire that joy of living which can only spring from understanding satisfaction in his work, from the feeling that he is definitely creating, definitely achieving something worthy of achievement, and something in which he can take pride; and from the ability to lead a fuller life in his hours of rest and recreation.

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(*Continued from Last Week*).

The filtrate is treated with double its volume of water and allowed to stand one hour before filtering. The precipitate appears to be a mixture of the leuco base and colour base, and its dry weight is 19 g. or 90 per cent., according to the reaction:

$$3C_{13}H_{10}N_2S+H_2C_2O_4 = C_{40}H_{26}N_6S_3+3H_2O+CO.$$

The melting point is not sharp, but is below 100°.

13. *Di-benzothiazolyl-Fuchsone-Benzothiazolylimine.*

The leucobase is then oxidized to the dye with lead peroxide by the method of Gatterman [50] using a suspension of the finely powdered material as it is insoluble. Heat and shake the solution for 15 minutes, and filter after adding the sodium sulphate according to his direction. Extract the precipitate with hot ethyl alcohol and precipitate with water.

The new dye has a deep purple colour but very poor tinctorial value, dyeing silk only a pale lavender from alcohol solution as it is insoluble in water. This is probably due to the fact that apparently the hydrochloride is unstable and is hydrolyzed by water, for a qualitative analysis showed C, H, N, and S, but no chlorine. It was then analyzed for nitrogen according to the method of Fisher [51] as were the other analyses.

Calculated for $C_{40}H_{26}N_6S_3$ N= 12.24%

Found N= 12.03%, 12.12%

14. *Sulphonation of the Dye.*

It was thought that the poor tinctorial value of the new substance might be due in part to its neutrality and extreme insolubility, so an attempt was made to sulphonate it with 15 per cent. fuming sulphuric acid. The sulphonation mixture was diluted with water, neutralised with barium hydroxide, and the precipitated barium sulphate was filtered off. The resultant yellow solution was concentrated and allowed to crystallise, depositing pale yellow plates, but as the hue of the dye appeared to be destroyed in the process, no further work was done on it.

15. *Nitro-tolyl Benzothiazole.*

In connection with the second and third purposes of this investigation, it was considered desirable to prepare some of the derivatives of the paratolyl benzothiazole, especially the nitro ones, because the nitro group frequently functions as an odorophore, as in the synthetic musks; and the amino derivatives, which would be isomeric with the valuable dehydrothiotoluidin which has already been mentioned a number of times.

The nitration of paratolyl benzothiazole may be accomplished with fuming nitric acid or a 1:1, by volume, mixture of concentrated sulphuric and nitric acids. The best procedure for moderate quantities follows:

50. *Gatterman, Practical Methods of Org. Chem.*

51. Fisher, *Lab. Man. of Org. Chem.*

In a small flask dissolve 2.5 g. of paratolybenzothiazole in 10 cc. of concentrated sulphuric acid, and add 10 cc. concentrated nitric acid. The solution becomes warm at once, nitrogen tetroxide is evolved, and the colour changes from yellow to reddish-brown. Heat on a water bath for one hour. Let cool and pour into 100 cc. of water. A bright orange-yellow precipitate settles out, which on drying weighs 3 g. The coloured impurities may be removed by warming on a water-bath with about 50-80 cc. of ethyl alcohol, and the residue can then be dissolved in 50 cc. of hot toluene, which on cooling deposits the mono-nitro derivative in pale cream-coloured, odourless crystals, M.P. 219.5° C. (cor.).

Calculated for $C_{14}H_{10}O_2N_2S$ N = 10.38%
Found N = { 10.51%, 10.56%

The nitration proceeds smoothly and quantitative yields according to the equation

$$C_{14}H_{11}NS+HNO_3 = C_{14}H_{10}O_2N_2S+H_2O$$

may be obtained from any weights. Toluene is a remarkably good solvent for purification, as the difference in solubility with temperature is strikingly great.

16. *Aminotolyl Benzothiazole.*

The nitro derivative was then reduced, using zinc or tin and hydrochloric acid according to the method of Gatterman. The amine forms an addition product with the metallic salts, from which it is a little difficult to remove the metal, and may be crystallised from ethyl alcohol, amyl alcohol, or toluene, none of which are good solvents as the substance is quite insoluble, but the last is the best of the three, and yields the base in small brown crystals, which are much lighter in colour on purverisation and melt at 229° C. (cor.). Amyl alcohol and toluene solutions exhibit a bluish-green fluorescence which is characteristic of most of the benzothiazoles.

Calculated for $C_{14}H_{12}N_2S$ N = 11.67%
Found N = { 11.80%, 11.90%

17. *Azo Dyes from Amino Paratolyl Benzothiazole.*

Amino paratolyl benzothiazole is not a dye, but can be diazotized on the fibre and coupled with the usual materials, and yields a series of direct cotton colours. This was done according to the method which will be described later, with the results noted in the table. With the amines as couplers, the developer was made up as a 2 per cent. solution by weight, using sufficient glacial acetic acid to dissolve them, and after the cloth was immersed, the bath was neutralised with 10 per cent. NaOH, thus precipitating the dye out in the fibres of the material. Other acids do not appear to give satisfactory results.

TABLE.

Base diazotized and coupled with:

	Coupler.			Colour.	Depth.
1.	Phenol			Yellow	Good
2.	Aniline			,,	Fair
3.	*p*-Cresol			Salmon orange	Good
4.	Para-toluidin			Yellow	Fair
5.	*B*-Naphthol			Pink	Good
6.	Alpha-naphthylamine			Brown	,,
7.	*B*-naphthylamine			Orange	,,
8.	Resorcinol			Yellow-brown	,,
9.	Benzoylene urea			Orange-pink	Poor
10.	(2)	diazotized	+resorcinol	Yellow-brown	Good
11.	(2)	,,	+B naphthol	Orange-pink	,,
12.	(2)	,,	+*p*-toluidin	Yellow	,,
13.	(12)	,,	+B naphthol	Orange red	,,
14.	(6)	,,	+anilin	Brown	,,
15.	(6)	,,	+phenol	,,	,,
16.	(7)	,,	+phenol	Orange	,,
17.	(7)	,,	+aniline	Orange red	,,
18.	base	,,	+phenylaminobenzothiazole	Yellow-brown	Poor
19.	,,	,,	+ammonia	Yellow	,,
20.	(6)	,,	+B naphthol	Purple	Good
	(7)	,,	+B naphthol	Orange	,,

These colours are all as fast to light, soap, bleaching, *etc.*, as the corresponding azo colours from dehydrothiotoluidin, and the tinctorial value in general appears to be much better, particularly of the browns, where it is really quite remarkable. To put it colloquially, "a little will go a long way." The specimens were all dyed from a 1 per cent. solution of the amine in the presence of sodium chloride according to the method given later, dried, and steam pressed.

The bis-diazo compounds are better than the primary diazo ones, both from a consideration of variety, and of depth of colour, particularly those of alpha and beta-napthylamines from which, as well as those given, a good series of browns may be obtained. It would be interesting and illuminating to determine if a series of greens could be obtained from this base by diazotizing and coupling with dioxynapthalene disulphonic acids, as in the case of dehydrothiotoluidin,[67] but unfortunately, the last two reagents were not available, and all other attempts to prepare a green or blue failed, with the exception of the one purple found in the chart, which, however, it is interesting to note, begins to approach these in structure.

18. *Para (2 Benzothiazolyl) Benzoic Acid.*

Paratolyl benzothiazole contains a methyl group which it should be possible to oxidize to the corresponding carboxyl group by methods analogous to other side chain oxidations. This was first attempted by means of potassium permanganate in neutral solution in the presence of magnesium sulphate according to Fisher. The permanganate was reduced, but the final yield of the expected acid from 5 g. of the thiazole was so small that it could only be crystallised once, and the amount was too small to proceed further with. The substance obtained was yellow white in colour and appeared to decompose, but did not melt up to 270°.

A second experiment was performed using permanganate in alkaline solution, according to the method of Bigelow,[68] and while the yield was larger than in the first case, 0.5 g. from 5 g. sample, it could not be purified sufficiently for analysis. The substance resembled that in the first experiment in every way, crystallising in microscopic white needles from alcohol, which darkened but did not melt up to 270° C.

19. *Primulineazo-Benzoylene Urea.*

It has been shown[69] that 1:3 dioxyquinolin is particularly suited, in combination with primuline diazotized on the fibre according to the process invented by A. H. Green, to give acid, light, and wash fast orange colours on cotton. The procedure is given in the patent, for example: one requires for a 2 per cent. primulin developed colour, a mixture of 1 per cent. 1:3 dioxyquinolin as the sodium salt, and 1.5 per cent. sodium carbonate in which the material is immersed after coming from the diazotizing bath. Dioxyquinolin gives a clear orange colour of greater acid-, base-, and wash-fastness than the corresponding phenol or resorcin developed colours. It was therefore thought that benzoylene urea which resembles dioxyquinolin closely, would also couple to give a dye exhibiting these valuable properties.

The procedure used in dyeing was a modification of that described in the Badische Co. Pocket Guide (p. 101), and as practical methods of this kind are not as readily accessible as might be thought at first, a brief summary is given.

(*a*) Before dyeing, boil the cotton in a water solution of sodium carbonate and wash with water.

(*b*) Enter the cotton into the dye bath (2 per cent. primulin) and work at a boil for 1½ hours, adding 5-30 lbs. of crystalline Glauber's salt or 2½ to 10 lbs. of sodium chloride for 100 lbs. of cotton.

(*c*) Dye cotton as just given and treat for one-half hour in a fresh, cold diazotizing bath, using 3 lbs. of sodium nitrite and 8¾ lbs. of concentrated hydrochloric acid per 100 lbs. of cotton, keeping the temperature below 50° F. by the addition of ice. Add the sodium nitrite to the acid, not *vice versa*. (This is an unnecessary precaution for laboratory procedure.) Rinse once in cold acidified water and enter into the developer for one hour.

(*d*) A typical developer bath (for ingrain red) consists of a 1 per cent. solution of beta napthol dissolved in warm water by means of an equal weight of sodium hydroxide.

For small amounts of material a 100 cc

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67. Clève, *Berichte*, 21, 3271 (1888); *D. R. P.* 69265.
Clève, *Bull. Soc. Chim.*, 26, 444 (1876).

68. Bigelow, *J. A. C. S.*, Vol. 41, 1559 (1919).

69. Bad. An. and So. F., *D. R. P.*, 210 453; Friedländer, 9-411.

working modification of this gives very good results. The diazotizing bath consists of 17 cc. of concentrated hydrochloric acid, 6 g. of sodium nitrite, and 200 cc. of water. The primulin in this experiment was a museum specimen furnished by the Casella Co., the benzoylene urea was a portion of that prepared by Scatchard,[70] and for purposes of comparison ingrain red (primulin-azo-beta-napthol) was used. Benzoylene urea as a developer gave a yellow brown colour that comes out much more slowly than the red.

Tests for fastness were made with these results:

Test.	B.U. Yellow.	Ingrain Red.
Boiling with 5% HCl	Fast	Fast
Boiling with 10% NaOH	Darkens slightly	Bleeds out
Bleaching powder	Not bleached	Not bleached
Direct sunlight—two weeks	Fades slightly more than red	
Soap solution, boiling	Fast	Fast

The tinctorial value of the new dye is just as good as ingrain red, and it appears to be of about the same order of fastness as the latter, except to prolonged exposure to light, but this is more than counterbalanced by its greater fastness to alkali.

PART B—DEHYDROTHIOTOLUIDIN.

This compound is prepared commercially, directly from paratoluidin and sulphur, and the methods are at variance on two principal points, the manner of conducting the fusion, which is either by a mixture of only the two substances in molecular quantities, or by the addition of a diluent such as napthalene or an excess of partoluidin, and the method of purification. In any event, much primulin and other substances are formed simultaneously, and their formation is greater in the presence of an excess of sulphur, and since dehydrothiotoluidin is the more valuable of the two, this is to be avoided. Of the patents already mentioned [44] the basic ones are those of Kalle and Co., of Biebirch am Rhein (a duplicate of the original one mentioned earlier with some changes). and of Leopold Casella and Co. Three methods of separation of the mixed bases which form the melt are available. The Casella patent appears to do so by a difference in the basicity of the two compounds, claiming that dehydrothiotoluidin is more soluble in a 30 per cent. by weight solution of sulphuric acid, while the Kalle patent effects this result by taking advantage of the fact that the ammonium salt of dehydrothiotoluidin sulphonic acid is less soluble in water than the corresponding derivative of primulin. The third method consists in distilling the melt in vacuo by which only dehydrothiotoluidin comes over, but from a commercial standpoint this method is unsatisfactory, and although it is being used at present, if there was a way of avoiding it, it would be abandoned due to the difficulties of the process in the plant.

Preliminary experiments showed that, in spite of the number of patents and the volume of literature on this subject, practical directions for the synthesis were noticeably lacking, and a critical study of all the methods was made with a view to supplying this deficiency from a laboratory standpoint at least.

1. *The Casella Method.*

The melt was prepared according to the patent directions in each case, substituting grams for "parts" in the wording of the patent. After heating, the fusion mixture was repeatedly extracted with 500 cc. portions of 30 per cent., by weight, sulphuric acid until nothing further was dissolved. The liquid extract was then drowned in water, or later diluted only a little more, and neutralised while warm with sodium hydroxide, which precipitates the mixed bases in a form which is more readily filtrable. The first factor investigated was the effect of length of heating time on the

44. Dahl & Co., *D. R. P.*, 35790; Friedländer, 1, 536.
Kalle & Co., *D. R. P.*, 92011; Friedländer, 4, 824.
Bayer & Co., *D. R. P.*, 65402; Friedländer, 3, 752.
Casella & Co., *D. R. P.*, 53938; Friedländer, 2, 293.
Picke, Lange & Co., *D. R. P.*, 52509; Friedländer, 2, 292.
Höchster Farbw. Co., *D. R. P.*, 104, 230; *Centralblatt*, 1899 (2) 950.

70. Bogert and Scatchard, *J. A. C. S.*, 41, 2052 (1919).

weight of the sulphuric acid extract, and it was found that there was very little advantage in keeping the melt in fusion longer than four hours. In extracting the melt it is desirable to keep the temperature below 100° C. on a water bath, when two extractions will remove all of the soluble material with a minimum of impurities. The yield at this point, however, after a number of experiments, was never better than 33 per cent. of the theoretical amount of the substance from the equation:

$$2C_7H_7NH_2 + 4S = C_{14}H_{12}N_2S + 3H_2S,$$

assuming the extract, for purposes of calculation only, to be pure dehydrothiotoluidin.

It was then attempted to purify the product by recrystallisation from solvents. The melting point of the crude extract varies from 165°-175° C. (uncor.). A single crystallisation of this from alcohol will bring the melting point up to 185°, and if this is then dissolved in the least amount of hot acetone, refluxed with boneblack for one-half hour, filtered, and allowed to crystallise, a pale yellow product in small needle crystals melting at 192° C. (cor.) is obtained.

There are two difficulties in this method. In the first place the losses by the two crystallisations are so great that it is not a satisfactory method of preparation even from a laboratory standpoint. The first one from ethyl alcohol must be done rapidly from the hot solution as it colours up and becomes tarry and resinous quickly, and purification by crystallisation is then impossible, so that of all of the extract cannot be utilised. In the second place the composition of the sulphuric acid extract seems to be decidedly variable, depending on the physical conditions during the extraction, so that there is frequently some difficulty in getting the first solution to crystallise at all, as dehydrothiotoluidin does not do so in the presence of large amounts of the higher primulines. It was first thought that this difficulty was due to the presence and oxidation of paratoluidin which can be shown to be present in considerable quantities even after eight hours' heating. (If the sulphuric acid extract, instead of being neutralised with sodium hydroxide as in the later experiments, is diluted with ten times its volume of water, the bases are completely precipitated and the filtrate will deposit nothing on further dilution, but if it is then neutralised with sodium hydroxide, a copious, flocculent, white precipitate is formed which can readily be shown to be paratoluidin). The idea then presented itself of freeing the mixed bases obtained from the sulphuric acid from paratoluidin by steam distillation before attempting to purify the dehydrothiotoluidin by crystallisation, but it was found that this did not solve the problem, as the paratoluidin apparently was not responsible for the difficulty. It was subsequently found in the literature that the same suggestion was made by Jacobson[71] in one of the earlier articles, and upon experiment he reached the same conclusion. It was also found by experiment later that pure dehydrothiotoluidin can readily be separated from moderate amounts of paratoluidin by crystallisation.

If the second crystallisation is made from cold acetone and the boneblack omitted, the substance crystallising out is dark brown and gummy, does not melt up to 220°, and cannot thereafter be obtained as light in colour as the preceding product, exhibiting, even after a prolonged boneblacking, an orange-yellow colour and slightly lower melting point.

71. Jacobson, *Berichte*, 22, 330 (1889).

(To be Continued.)

THE SELENIUM-SULPHUR COMPOUNDS.

By John Missenden, B.Sc.

Both Ditte and Gerichten have described a number of substances that they believed to be compounds of selenium and sulphur, but which were later proved by Bettendorf in the *Annalen der Physik und Chemie* and by Divers in the *Chemical News* (Vol. LI., p. 24) to be mixtures of the two elements, and not compounds. Some diversity of opinion has been held over the actual group formation of the few known selenium-sulphur compounds, but experiment has shown that these formations are fixed and definite.

The first of the category is the simple composition of selenium with sulphur and oxygen, a rich green substance being formed. This is *selenosulphur trioxide*, $SeSO_3$, and it is most easily obtained by dissolving pure selenium in concentrated sulphuric acid, although another method is to dissolve it in sulphur trioxide, providing the latter be very cool and newly distilled (Roscoe). Upon heating strongly, selenosulphur trioxide decomposes without fusion into sulphur dioxide, selenium dioxide, and selenium.

It is due to Schulze that the next compound, *selenotrithionic acid*, $H_2SeS_2O_6$, is obtainable in the free state. It is produced when selenious acid, H_2SeO_3, is brought into contact with a considerable excess of sulphur dioxide, the reaction being:

$$H_2SeO_3 + 3SO_2 = H_2SeS_2O_6 + SO_3.$$

A potassium salt of this acid may be obtained when an excess of normal potassium sulphate and a concentrated solution of selenious acid be treated with a solution of potassium selenosulphate, the reaction being:

$$SO_4K_2 + SSeO_3K_2 + SeO_3H_2 = K_2S_2SeO_6 + SeO_3K_2 + H_2O.$$

The correct group formation of selenotrithionic acid is:

$$SeS_2O_4(OH)_2.$$

Schulze also discovered that when sulphur dioxide is kept in the presence of an excess of selenious acid, another acid compound is obtained, haviug the formula $H_2SSe_2O_6$.

Sulphoselenoxytetrachloride, $ClSO_2(OSeCl_3)$, is little known, but may be produced by the action of selenium tetrachloride upon chlorosulphonic acid, $HClSO_3$ (sulphuryl-hydroxychloride). It takes the form of a conglomeration of white crystals which melt at 165.8° C., the resultant liquid boiling at 183.5° C.

Selenosulphuric acid, H_2SeSO_3, has never been known in a free state, and in this respect, as well as in others, it is analagous to thiosulphuric acid. It is responsible for a series of selenosulphates which are isomorphous with the thiosulphates. These selenosulphates, too, are readily decomposed by all the acids with the production of red selenium. The potassium salt of selenosulphuric acid is obtained by treating a solution of potassium selenide with one of sulphurous acid; while it may also be obtained by dissolving selenium in a solution of normal potassium sulphite in the presence of selenotrithionic acid. The group formation of selenosulphuric acid is:

$$SO_2 \left\{ \begin{matrix} OH \\ SeH. \end{matrix} \right.$$

A NEW METHOD FOR THE DETERMINATION OF BISULPHITES.

Fr. Kühl, B.Sc., Copenhagen.

[Reprinted from the "Journal of the Society of Leather Trades' Chemists," June, 1922, Vol. 6, No. 6, Page 199.]

There are two well-known methods for the estimation of bisulphites:

(1) A technical alkalimetric method according to the equation:—

$$NaHSO_3 + NaOH = Na_2SO_3 + H_2O,$$
$$SO_2 + 2I + 2H_2O = H_2SO_4 + 2HI.$$

This method alone does not differentiate between normal sulphite and bisulphite, but by combining this method with the alkalimetric method it is possible to estimate both sulphites and bisulphites.

The author, however, prefers the following method:—2 gms. of the bisulphite are using phenol phthalein as indicator.

This method, however, suffers from the disadvantage that bisulphate is estimated as bisulphite.

(2) *Iodometric Method.*—In acid solution the following reaction takes place:—dissolved in water and titrated with normal NaOH (*a* cc.) This titration is a measure of the total acidity. 10 cc. of neutral 40 per cent. HCHO solution are added, which causes the liberation of caustic soda:—

$$Na_2SO_3 + H.CHO + H_2O = H.CHO.NaHSO_3 + NaOH$$

and the formation of the well-known sodium bisulphite-formaldehyde compound. The liberated NaOH is then titrated with normal HCl (*b* cc.). 1 cc. N/1 HCl ≡ 0.064 gm. SO_2.

The following results are possible:—

(1) $a=b$.—If any impurities are present, they are neutral such as sodium sulphate.

(2) $a>b$.—Acid impurities are present. The difference $a-b$ is calculated as bisulphate ($NaHSO_4$).

(3) $b>a$.—Normal sulphite is present. The difference $b-a$ is calculated as normal sulphite (Na_2SO_3).

Results obtained by:—

Iodometric Method .. 57.9 per cent. SO_2.
This Method .. .. 58.2 per cent. SO_2 consisting of 86.3 per cent. $NaHSO_3$ and 10.1 per cent. Na_2SO_3.

CORRESPONDENCE.

To the Editor of "The Chemical News."

Dear Sir,—As I have ample means of exhaustive research, I beg that you will be so kind as to communicate to your readers that should any point arise connected with new fields of discovery or with discovered matter that requires verification, it will be a great pleasure to me if they will send me their problems through your good offices, and I will examine them and let them have a note upon my results.

My object in doing this is to further the cause of Science in the service of humanity; and, as my time is almost wholly devoted to such studies, especially with

regard to the rare earth metals, such an opportunity of helping my fellow-experimenters would be both gratifying to myself and possibly beneficial to them.

Yours, &c.,

JOHN MISSENDEN, B.Sc.

7, Beach Road, Lowestoft.
22nd June, 1922.

THE COST OF SCIENTIFIC BOOKS.

To the Editor of "The Chemical News."

SIR, — I am one of those who endeavour to keep abreast of modern developments in chemical and physical science, and who value your Journal as a means to that end. Frequently I read a notice in your columns of some scientific book which inspires me with a desire to increase my knowledge by studying it, but not seldom is this desire frustrated by the high price asked for the book in question. I am convinced that the present high prices demanded for their wares by many publishers of scientific books, on the one hand, are acting as a deterrent to the advance of scientific knowledge, and, on the other, are totally unwarranted. The costs of production are certainly much higher than before the war, but they are by no means so high as some folk would have us believe. I can instance the case of my book, *Alchemy: Ancient and Modern*, of which a second edition* has just been published by Messrs. Wm. Rider & Sons, in refutation of those who assert that the present high prices are necessary. Without conceit, since for these things Messrs. Rider & Sons, and not myself, are responsible, I can say that the printing, paper, and binding of this book are excellent. It contains sixteen full-page lithographed (not half-tone) plates, and yet the publishers can afford to sell the book at 7s. 6d. Many firms are asking as much as 20s. for scientific books, and even ordinary text-books, which—whatever the excellence of their contents may be—certainly never cost as much to produce. In the interest f science a strong protest against these inflated prices seems very desirable.

Yours, &c.,

H. STANLEY REDGROVE, B.Sc., F.C.S.

191, Camden Road, N.W.1.
29th June, 1922.

* Admirably reviewed in your issue of April 7th, 1922.

MATTER AND ENERGY.*

To the Editor of "The Chemical News."

SIR,—In your reviewer's notice of Prof. A. W. Stewart's book, "Some Physico-Chemical Themes," this Journal, June 23, 1922, p. 369, the following statement appears:—

"Whatever subsequent research may prove, it is beyond dispute that Ostwald has contributed considerably to the advancement of science, both by his own researches and by his inspiration of others. His belief in the fundamental importance of energy and his preference for this concept in place of that of matter, has recently received much support from Einstein's theory of Relativity."

With your permission, I should like to direct attention to a few considerations which the above calls to mind as being relevant to the problem of *matter* and *energy*. In the first place, Einstein's theory does not involve anything in the nature of a *model* or a material *mechanism*. Eddington, in his "Time, Space and Gravitation," says: "Einstein . . . deduces a great number of remarkable phenomena solely from two general principles, aided by a mathematical calculus of great power; and it leaves aside as irrevelant all questions of mechanism." It is purely a system of analysis and, while Einstein holds the view that the atom is in some way characterisable by the energy it contains (e.g., its mass may be due to confined energy), the existence of atoms as discrete and measurable entities is in no way negatived by the Relativity Theory. This theory gains in strength because it does not specify the nature of the mechanism involved in the phenomena considered or elucidated by the theory. *At the same time, this lack of* model characteristics is its weakest point, for great strides have also been made in the example of the atom by considering the atom as an entity with mechanical and electrical properties; but, as pointed out by N. R. Campbell, mechanical-model theories are liable to greater error than purely mathematical theories, because the former of necessity states more and consequently the danger of error is greater.

Any attempt to eliminate the term *matter* seems to be doomed in the long run, for however we may construct atoms and electric fields, the self-contained entity characteristic of atoms implies something which convention and convenience may sum

up by the term *matter*. We might almost as well try to eliminate the atom from consideration. It is true that the atoms are supposed, with good reason and abundance of experimental proof, to be composed of positive electrons (protons) and negative electrons. The negative electron has been described as a singularity in the æther. If the positive electron is an opposite singularity in the æther, we have two singularities, and by such ultimate terms we can avoid the use of the older terms which have a greater value because their extended definition is not attempted. Why, then, should we disparage the use of the word matter?

Aston's work on isotopes is an example of the materialness of the atom. Not a long time ago it was suggested that the appreciable atomic-weight fractions were due to the confined energy within the atom arising from different energy contents in different cases. It is now known that the *appreciable* fractions (except in the case of hydrogen) arise from the presence of isotopic atoms,* and these fractions are simply average figures and nothing more. We cannot say that the decimal fraction of chlorine, 0.46, is directly due to an energy condition; for this fraction is only a mean figure since chlorine is made up of atoms of masses 35 and 37 in such proportions as to give a mean value of 35.46. This was discussed in the *Chemical News* (Vol. CXI., p. 181, April 16, 1915) by the present writer. Relatively enormous energy is nevertheless involved in atomic disintegration, and there are reasons for supposing that *all* atoms contain, relatively to their size, great amounts of internal energy, but one must avoid rushing to extremes in drawing conclusions. It is somewhat difficult in these times of great advance by totally different methods not to lose sight of the importance of one when absorbing the other. Within limits, two views apparently leading in opposite directions may be right, so long as we interpret them in the light of the experimental facts which are supposed to guide us. Modern developments in pure science lead to conflictin gideas, and it is a fact that, as Prof. Bragg has remarked, on several days in the week we may work with one theory, and on the other days with another theory, though we, in our ignorance, are unable to reconcile the two theories themselves.

It cannot be denied that these advances in science, as conflicting as they seem, are truly fascinating, and one awaits with keen interest the experimental developments.

It has been remarked that the statement of modern views may be such as to leave the reader in doubt as to the proper choice of view, and that it would have been better if the statement had been crystallised into some definite form. Until this can be done with absolute certainty, it seems desirable to leave the final shaping of the argument until more is known.—I am., &c.,

F. H. Loring.

June 25th, 1922.

* There may be some exceptions to this rule, but in general it is true.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

Ordinary Meeting—June 22, 1922.

G. I. Taylor, F.R.S. *The Motion of a Sphere in a Rotating Liquid.*

The problem attacked in this paper is that of finding solutions to the equations of motion of a rotating fluid when a sphere is moved uniformly along the axis of rotation. It is shown that there are an infinite number of such solutions which satisfy the required boundary conditions and the conditions at infinity. They are characterised by a system of spherical rotational waves which accompany the sphere in its motion. The stream-lines are drawn for a particular case.

It is found that the radius of the sphere may be reduced to zero without reducing the disturbance in the fluid to zero. The equations then represent a motion which is finite and continuous at the centre (*i.e.*, centre of the sphere of zero radius), and consists of a central core or lump of fluid which rotates more slowly than the surrounding fluid and travels along the axis with a constant speed.

Experiments are also described in which some of the conclusions are verified with celluloid spheres moving in rotating tanks full of water.

Prof. T. R. Merton, F.R.S., and D. N. Harrison. *On Errors arising in the Measurement of Unsymmetrical Spectrum Lines.*

It is shown that the instrumental displacements which frequently occur whilst

spectra are being recorded photographically, can be rendered innocuous, for wave-length determinations, only in the case in which it is known that the spectrum lines are symmetrical.

In the case of a uniform displacement of a spectrum line during an exposure, the maximum on the photographic plate lies at the point where the intensity distribution curves at the beginning and end of the exposure intersect. In the case in which the intensity distribution curve is such that the ratio of the widths on either side of the maximum remains constant for all values of the intensity, the displacement of the maximum is related in a simple manner to the "index of asymmetry" of the line.

E. F. Armstrong, D.Sc., F.R.S., and T. P. Hilditch, D.Sc. *A Study of Catalytic Actions at Solid Surfaces. Part VIII.—The Action of Sodium Carbonate in promoting the Hydrogenation of Phenol. Part IX.—The Action of Copper in Promoting the Activity of Nickel Catalyst.*

Part VIII.—In this part an account is given of the stimulating action of small amounts of mild alkali, especially anhydrous sodium carbonate, upon hydrogenation of phenol in the liquid state in presence of nickel. We have established the following facts:—

(i) The amount of sodium carbonate present has a specific influence—as the quantity is increased, the hydrogenation is accelerated until a certain point is reached, after which the rate of action again falls off.

(ii) The optimum amount of sodium carbonate is about 25 per cent. of the weight of metallic nickel present, and bears a constant ratio to the latter and not to the amount of phenol present.

(iii) The hydrogen-absorption time curves for phenol in presence of nickel and in absence of sodium carbonate are of logarithmic type; in presence of the optimum concentration of carbonate, however, they become approximately linear.

It is deduced that the action of the sodium carbonate is a protective one with respect to the catalyst, and not a true acceleration; it is rather the suppression of a retarding or poisoning influence, leaving the nickel free to exercise its normal function. Whilst the actual toxic agent has not been identified, it would appear in the light of these results to be some too stable association between the nickel and phenol (or a product from the latter). The cause may possibly be formation of nickel phenate.

The authors propound no general theory of "promoting action" induced on catalysts.

Part IX.—In this part the production of catalysts by reduction of mixed copper-nickel carbonates below 200° C. has been studied, and it is emphasised that comparison between catalysts should be made under conditions in which the simple catalyst (nickel alone) is mechanically distributed to give maximum surface area.

In this way it was found that copper-nickel catalysts prepared at 180° C. are not so highly active as the plain nickel catalyst reduced at a higher temperature, but nevertheless display considerable activity. Only certain nickel-copper carbonates give rise to active catalysts, and to obtain maximum activity in the product it was necessary so to prepare the mixed carbonates that nickel α-cupri-carbonate was present in the precipitate.

The preparations which yielded active catalysts responded to Pickering's tests for complex cupri-carbonates; those which yielded inactive products gave negative results in these tests. The amount of reduced nickel in the active products was small, and never more than 12-15 per cent. of the total quantity present.

It is suggested that the production of reduced nickel at the low temperature of 180° C. from a nickel cupri-carbonate is conditioned by the heat liberated in the reduction of the copper, which may give rise momentarily to a local temperature in the complex carbonate molecule far higher than the recorded external temperature.

E. A. Milne. *Radiative Equilibrium: The Relation between the Spectral Energy Curve of a Star and the Law of Darkening of the Disc towards the Limb, with special Reference to the Effects of Scattering and the Solar Spectrum.* Communicated by Prof. H. F. Newall, F.R.S.

It is shown that for stars in radiative equilibrium the darkening of the disc towards the limb in wave-length λ depends only on the product λT, T being the effective temperature. The ratio of the intensity at the limb to that at the centre increases as λT increases, but never exceeds 0.8; it approaches zero for small values of λT. For stars not in radiative equilibrium the coefficient of darkening in the integrated radiation must lie between 3/5ths and $\frac{1}{2}$.

and the temperature distribution near the surface can be deduced from the observed value.

These results hold on the assumption of "gray" material, *i.e.*, material for which the coefficient of absorption is independent of wave-length. Selective absorption in the continuous spectrum alters the law of darkening, giving increased contrast in the relatively more intense parts of the spectrum. The effect of a scattering atmosphere round a star should be to make the coefficients of darkening in all wave-lengths tend to the same value, about 3/5ths.

Though the continuous solar spectrum differs considerably from a black-body spectrum, the observed darkening differs very little from the theoretical darkening for radiative equilibrium. For the sun it is not possible to correlate the spectrum with the darkening, either on the hypothesis of selective absorption or on that of a scatter-atmosphere. It is inferred that there is no scattering atmosphere of appreciable optical thickness round the sun, and that the bulk of the emergent radiation is not scattered light.

C. N. Hinshelwood. *On the Structure and Chemical Activity of Copper Films and the Colour Changes accompanying their Oxidation.* Communicated by Prof. J. W. Nicholson, F.R.S.

1. The gradual activation of a copper surface in a series of oxidations and reductions has been studied by measurements at pressures of a few millimetres.

2. A limiting state appears to be reached in which the copper film has an open structure consisting of granules whose radius is found to be a small fraction of 1μ.

3. During oxidation brilliant diffraction colours are observed, which depend upon the composition of the separate granules. Measurements of the composition of the granules in films showing the various colour stages are given.

4. Upon optical observations and upon the study of the kinetics of the oxidation and reduction is based a suggestion as to the mechanism by which the film is brought into the granular condition.

R. C. Ray. *Heat of Crystallisation of* se. *Quartz.* Communicated by Dr. M. W. one th...ers, F.R.S.
other the...y, specific heats of aqueous hydro-
are unable to of different concentrations have
themselves. mined and the results rec...
It cannot be ...).

(2) The heats of solution of quartz and silica glass in aqueous hydrofluoric acid have been determined (Table II.), and the difference which represents the heat of crystallisation of quartz at the ordinary temperature is found to be equal to 6.95 kilogram calories.

(3) From determinations of the heats of solution (Table III.), it has been shown that grinding affects the crystalline material, which is partially converted into the vitreous state.

(4) The latent heat of crystallisation of quartz has been calculated at higher temperatures, and it is shown that near the melting point the heat of crystallisation of quartz is probably very nearly equal to that of the air temperature.

C. G. Schoneboom. *Diffusion and Intertraction.* Communicated by Sir E. Rutherford, F.R.S.

It has been proved by experiments, sc planned as to exclude the influence of con vection currents due to mechanical or ther mal influences, that in addition to diffusioı there also comes into play in connectio: with fluid-mixing another specific operatin factor, which has been called "Intertra tion."

Clerk Maxwell, in discussing the questic of interfacial tension, came to the concl sion that an interpenetrating movement this kind, although it had never been d scribed, was *a priori* to be expected as t result of negative interfacial tension.

The occurrence of the phenomenon h been described by Sir Almroth Wright the special case of the admixture of seru and salt solutions, but it is shown in t experiments detailed in this communicati that it is a general phenomenon which c be obtained with practically any substa in any solvent.

Thursday, June 29, 1922, at 4.30 p.m

Papers read:—

Sir J. J. Thomson, O.M., F.R.S. the Analysis by Positive Rays of Heavier Constituents of the Atmosphere the Gases in a Vessel in which Rad Chloride had been stored for 14 years; of the Gases given off by Deflagr Metals.

Sir Robert Hadfield, F.R.S. The C sion of Iron and Steel.

W. B. Dawson, D.Sc. Harmonic Constants for Standard Ports of Refe

in Canada. Communicated by Prof. F. D. Adams, F.R.S.

Prof. J. C. McLennan, F.R.S., and M. L. Clark. On the Excitation of Characteristic X-rays from Light Elements.

J. C. Bramwell. An Abnormal Relationship of the Electrical to the Mechanical Response in the Ventricles. Communicated by Prof. A. V. Hill, F.R.S.

T. S. P. Strangeways. Observations on the Changes seen in Living Cells during Growth and Division. Communicated by Mr. W. B. Hardy, Sec. R.S.

And other papers.

ROYAL INSTITUTION OF GREAT BRITAIN.

Albemarle St., Piccadilly, W.1.

A General Meeting of the members will be held on Monday, July 3, 1922, at 5 p.m.

SOCIETY OF GLASS TECHNOLOGY.

Report of the Meeting held on Wednesday, June 21st, 1922.

The members of the Society of Glass Technology, who met at the University of Sheffield, under the presidency of Prof. W. E. S. Turner, were disappointed to learn that the American Ceramic Society had decided to postpone their visit to this country until next year. The members of the Society had been expected to spend three or four weeks in this country in September, and a draft programme had already been prepared of visits to various glass and pottery centres. In view of the postponement, the Society decided to re-issue their invitation for next year, and also to approach the British Ceramic Society with the suggestion that that body should join in the invitation and arrangements.

Various interesting questions concerning glass-making were discussed at the meeting. A paper was received from a Japanese member, Mr. Y. Amenomiya, on "The Devitrification caused upon the Surface of Sheet Glass hy Heat." The glass referred to is that used for windows, and it is known that heat causes devitrification, or crystallisation. The object of the tests described in the paper was to find the temperature at which this alteration took place, and it was discovered that the danger region was from 700 to 800° C.

Two papers were read hy students of the Department of Glass Technology on research work they had carried out under the direction of Professor Turner. Mr. K. Kamita gave an account of the work he had done on the influence of alumina in preventing the devitrification of sheet glass during the drawing process. From seven melts of a standard glass to which had been added various quantities of alumina, he showed that as the amount of alumina in the glass increased so the temperature at which devitrification occurred was raised; 5 per cent. of alumina causing a rise of approximately 100° C. in the temperature at which devitrification commenced.

Mr. L. E. Norton gave an account of the work he had done on the swelling of sand on the addition of water. This matter was of importance, because many glass manufacturers still have their batch materials measured out instead of having them weighed out. Three typical sands were used in the experiments, and it was shown that in each case the addition of water caused such a swelling in the sand that the moist sand would more than fill a vessel which would hold the same sand when dry. This excess sand may be as much as 12 or 15 per cent. of the total dry sand. In each of the three cases there appeared to be a maximum amount of swelling when about 5 or 6 per cent. of water was mixed in with the sand.

Professor Turner gave a short paper on the mixing of batch, in which he compared the efficiency of hand mixing with mixing by machine. Taking three samples from a batch mixed in the ordinary way by hand, he found the maximum variations were from 44 to 77 per cent. sand and 4.8 to 8.3 per cent. lime, while a somewhat similar batch mixed hy machine showed variations of from 69 to 73 per cent. sand and 4.2 to 6.6 per cent. lime.

Machine mixing, by giving a much more regular batch, assisted the melting, and materially reduced the time necessary for the production of good glass.

An interesting discussion followed each of the papers.

During the morning a party of members visited the new works of the Department at Darnall Road, Sheffield.

It was pointed out that this was the last meeting of the present session. The new session will open in October, when the Society will probably visit York, to inspect the wonderful stained glass in the Minster.

BOOKS RECEIVED.

Chemical Lecture Diagrams. DR. GEOFFREY MARTIN, D.Sc. (LOND.), PH.D., &c. Pp. 88. 1922. Sampson Low, Marston & Co., Ltd., 100, Southwark Street, S.E. Price 3s. 6d. net.

Proteins, and the Theory of Colloidal Behavior. JACQUES LOEB. Pp. XI. + 292. First Edition. Messrs. McGraw-Hill Publishing Co., Ltd., 6 & 8, Bouverie Street, E.C.4. Price 15s. net.

The Calculations of Analytical Chemistry. EDMUND H. MILLER, PH.D., Professor of Analytical Chemistry in Columbia University. Pp. X. + 201. Third Edition. 1922. The MacMillan Company, St. Martins Street, W.C.2. Price 9s.

Chemical Lecture Diagrams. DR. GEOFFREY MARTIN, D.Sc. (Lond.), Ph.D., &c. Pp. 88. 1922. Sampson, Low, Marston & Co., Ltd., 100, Southwark Street, S.E. Price: 3s. 6d. net.

NOTICES OF BOOKS.

A Textbook of Inorganic Chemistry. Edited by J. NEWTON FRIEND, D.Sc., PH.D., F.I.C. Vol. IX., Part II.: *Iron and its Compounds.* Pp. XV. + 265. London: Charles Griffin & Co., Ltd., 1921. Price 18s.

Part II. of Vol. IX. of Dr. Friend's Textbook has been written by himself, and deals with Iron and its Compounds. Nothing is said concerning the metallurgical chemistry of iron which will be covered by another part (III.).

Whilst the chapters on the history and corrosion of iron are especially informative and complete, comparatively little is said concerning the industrial applications of iron compounds.

The arrangement of the matter is unusual and follows the periodic classification of the elements. Thus chapter VI. deals with the compounds of iron with hydrogen and the halogens; and chapter VII., entitled *Iron and the Elements of Group VI.*, includes accounts of the oxides, hydroxides, sulphides, sulphates, alums, thionates, and many other salts.

There are copious references to the literature of iron and its compounds. The utility of this volume is enhanced by the inclusion of "Tables of Dates of Issue of Journals" since some have appeared irregularly and others have volumes commencing in one year and extending into the next.

The book will become a standard work of reference on the metal, and will be freely consulted by those interested.

J. G. F. D.

Laboratory Outline to General Chemistry, by H. N. McCOY and ETHEL M. TERRY. Pp. VII. + 155. New York: McGraw Hill Publishing Co. (London: 6-8, Bouverie St., E.C.4), 1920. Price 7s. 6d.

This brief Laboratory Outline has been written to accompany the authors' "Introduction to General Chemistry," to which frequent cross references are made in the text. The two books together furnish the basis of a first year's course in chemistry.

A few paragraphs on chemical arithmetic have been inserted, and lists of apparatus are given in the form of an appendix.

Unfortunately, the book may not receive adequate consideration in England, owing to dislike of the American spelling of sulphur, etc. J. G. F. D.

The Determination of Hydrogen Ions, by W. MANSFIELD CLARK, M.A., PH.D. Pp. 317. Baltimore: Williams and Wilkins Company. 1920.

A conception of the great utility of the methods of physical chemistry in applied science is gained by a perusal of this work of Dr. Clark, who is engaged at the Research Laboratory of the Dairy Division, U.S. Dept. of Agriculture.

The book includes a full account of acic and base equilibria, the effect of dilutior and the behavious of strong electrolytes The theory and application of Indicators i then dealt with, and its limitations ar pointed out. A chart shows the colours o eight synthetic indicators at nine differen hydrogen ion concentrations (from acid t alkali).

There is a full account of the electro metric methods for determining hydroge ion concentrations, together with the theor of hydrogen, and calomel electrodes, poten tial differences at liquid junctions, and ap paratus receives adequate notice.

The useful chapter on Applications i rather too condensed, but the bibliograph is very considerable, occupying over 6 pages.

A portrait of Prof. Sörensen, who has s largely applied the ionic theory to biologic science, forms the frontispiece.

The author dedicates his work to his "Fellow Workers in the Biological Sciences," and these will welcome his valuable contribution to the literature of applied physical chemistry. J. G. F. D.

Chemical Engineering, by EDWARD HART, PH.D. Pp. XII. + 211. Easton, Pa: The Chemical Publishing Co., 1920. Price $4.

Among the various industrial processes dealt with in this interesting book, mention may be made of Solution, Filtration, Evaporation, Crystallisation, and Drying. Boilers and Machinery receive fairly adequate treatment. The chapter on Materials is one of the best and most informative, but the author is inclined to err on the side of brevity, and confines himself to a description of only one of each kind of plant (all American). Only modern types are included. Not only are obsolete processes omitted, but very few comparisons are made. From the students' standpoint this is regrettable.

Very few errors occur in this well-printed volume. The word *resistivity*, on p. 12, could be altered to *resistance* in future editions ,and some of the 200 illustrations could be improved upon, although most are quite good. Fig. 195 is merely a repetition of Fig. 73.

There is a need for books of this type, and Dr. Hart's volume should be of service to chemical engineers and to students.

J. G. F. D.

Practical Biological Chemistry, by G. BERTRAND and P. THOMAS. Translated from the Third Edition by HECTOR A. COLWELL, M.B., D.P.H. Pp. XXXII. + 348. London: G. Bell and Sons, Ltd., 1920. Price 10s. 6d.

The chief feature of this work is its broad and practical character. Part I. (Statics) includes a brief systematic account of the detection and estimation of the elements, and descriptions of groups of organic compounds of biological importance. Numerous tests, preparations and estimations are incorporated.

Part II.—Dynamics—deals with the various enzymes and their actions, microbiology, fermentations and the chief products therefrom, and certain synthetic processes. The laboratory experiments described are of fundamental importance, and illustrate the properties of bodies of biological interest. It is noticeable that certain methods have been selected for fuller treatment. Thus, there is a long account of the estimation of sugars by Bertrand's method, and also of Duclaux's noteworthy method for identifying and estimating volatile acids.

The translator has added a few useful notes, but hydroquinone is miscalled a *diatomic* phenol (p. 100). A more typical apparatus for distillation *in vacuo* could have been figured on p. 99.

The book is well adapted for the use of medical students and others. It should appeal to those who teach biochemistry.

J. G. F. D.

CHEMICAL NOTICES FROM FOREIGN SOURCES

VOLUMETRIC DETERMINATION OF AMMONIA. —*E. J. Kraus.*—A volumetric method can conveniently be used to determine small quantities of aluminium, as, for example, in a precipitate obtained from waters which are rich in aluminium. The method depends upon the fact that when an alkaline phosphate is added to a liquid containing the ions, $Al^{\cdots}$ and $Ag^{\cdot}$ argentic phosphate, Ag_3PO_4, is not precipitated until all the aluminium has separated in the form of aluminium phosphate, $AlPO_4$. The aluminium must be present in a neutral or very feebly acid solution. The precipitate of $Al(OH)_3$ is dissolved in dilute sulphuric acid, two drops of a solution of silver nitrate are added, and then some disodium phosphate solution of known strength, till a yellow precipitate is obtained. It is best to warm the solutions, as it is then easier to see the yellow colour of the silver phosphate.—(*Chem. Ztg.*, 1921, 1173).

HYPOTONIN.—*Th. Sabalitschka.*—Hypotonin is an iso valerianate of ethylene diamine, in which an anune which lowers the blood pressure is associated with an acid having a sedative action. It is a white powder with a smell resembling that of valerian, and a sweet taste. It fuses at 129-130°. At the ordinary temperature it dissolves in less than its own weight of water and in four parts of absolute alcohol. It is less soluble in chloroform, and only slightly soluble in ether. The aqueous solution is feebly acid towards litmus. With sulphuric acid it yields an oily, colourless liquid, smelling strongly of valerian, and when boiled with caustic soda solution it gives off vapours with a peculiar smell, which are not ammoniacal, but which do turn damp litmus paper blue. If a glass rod previously dipped in hydrochloric acid is brought into the vapour a white cloud of

ethylene diamine is obtained. When ignited hypotonin gives a residue amounting to only 0.1 per cent. of its weight.—(*Pharm. Ztg.*, 1922, 327.)

BENZYL DI-ALKYLATED CYANIDES, AND THE CORRESPONDING ALCOHOLS, AMINES, AND ACIDS.—*Joseph Blondeau.* — The di-alkylated cyanides of benzyl can be prepared from the monalkylated cyanides by treating them with the theoretical quantities of sodium amide and methyl iodide. When these cyanides are saponified with potash and alcohol, the corresponding amide is obtained, with traces only of acid, and the amides can readily be reduced by means of sodium and absolute alcohol, the corresponding alcohols being thus obtained. The author has prepared many compounds of these types, and has studied their properties.—(*Comptes Rendus*, CLXXIV., 1922, 1424.)

ACTION OF ACETYLENE UPON THE SODIUM-KETONES AND THE PREPARATION OF DIALKYL-ETHINYLCARBINOLS.—*R. Locquin and Sung Wouseng.*—When the sodium derivatives of various ketones are shaken with acetylene at a temperature of 0° and under a pressure of ½ an atmosphere, the gas is rapidly absorbed and tertiary acetylenic alcohols are obtained. They are mobile liquids, characterised by their phenylurethanes and by their allophanates. They give an argentic derivative which is unaffected by boiling water. When hydrogenated in presence of platinum black or reduced nickel they yield the corresponding tertiany saturated alcohol. Some condensation products of the ketone with itself are also obtained by the reaction and bitertiary acetylenic γ-glycols existing in two stereo isomeric forms.—(*Comptes Rendus*, CLXXIV., 1922, 1427.)

METHOD OF PREPARING BISMUTH CITRATE AND TARTRATE.—*M. Fabrègue.* — Bismuth citrate can be prepared by dissolving neutral bismuth nitrate in acetic acid, and shaking the solution with sodium citrate. A white precipitate of bismuth citrate is thus obtained. It is insoluble in water, alcohol, ether, and dilute acids, but soluble in water containing ammonia, giving double salts. It is slightly acid towards litmus. It gives more or less basic salts when neutralised with ammonia or caustic soda or sodium carbonate and evaporated to dryness. Bismuth tartrate can be prepared by the same method, using sodium tartrate instead of citrate. It is a white crystalline powder, very closely resembling the citrate, and it can be used for intra-muscular injections instead of the latter. — (*Journ. Pharm. Chim.*, I., 1922, 341.)

New Patents.

THIS list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

16086—Aktieselskabet Norske Saltverker.—Process of producing anhydrous magnesium chloride. June 9.

15856—Chemische Fabrik, J. A.—Process for production of water-soluble permanent preparations containing acetylsalicylic acid. June 7.

15872—Maxted, E. B.—Manufacture of nickel catalyst for hydrogenation of oils, etc. June 7.

16170—May & Baker, Ltd.—Manufacture of 3;3′:-diamino 4;4′-dihydroxyarsenobenzene, etc. bases. June 10.

15741—Schindelmeiser, J.—Production of camphor, borbeol, and isoborneol. June 6.

Specifications Published This Week.

160161—Kansas City Gasoline Co.—Art of cracking hydrocarbons.

180433—Imray, O. Y.—Manufacture of mordant dyeing dyestuffs and chromium compounds thereof.

161161—Christenson, O. L.—Method of producing ammonium chloride in combusting or distilling alum, slate or similar bituminous shales.

169948—Christenson, O. L.—Method of producing ammonium chloride from shales.

180546—Gailard, E. A.—Manufacture of sulphuric acid.

180611—Wilson, Bros.—Vegetable charcoal.

Abstract Published This Week.

Ammonium Sulphate.—Patent No. 178046.—Some improvements in the manufacture of ammonia sulphate have been Patented by Mr. R. Lessing, of 317, High Holborn, London.

The paste of crystals discharged from the saturator is allowed to drain under conditions which prevent further crystallization during the draining process. Preferably the paste is discharged into a closed draining-vessel, which is heated to a temperature not above that of the crystals. The process may be carried out in conjunction with that described in Specification 152766, for improving the colour of ammonium sulphate.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

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